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THE PRICE OF NEW SECURITIES.

The determination of the price at which new stock shall be issued by a public-utility corporation subject to the supervision of a state commission is one of the most trying problems which the management has to face. Where, as in Massachusetts, the commission is required to pass upon the proposed price of new stock as fixed by the directors of the company, the reviewing tribunal encounters a perplexing responsibility. In its broadest aspects this problem is essentially a question of financial policy; but, while it has little direct connection with engineering, it is of large importance to the public-service corporation which may be trying to raise money for the purpose of carrying out absolutely necessary or plainly desirable engineering improvements.

It seems reasonable that when those who have nursed a public utility from an uncertain infancy to a mature and developed prime find it necessary to secure more capital, in order to carry on the work of the company in the general public interest, some allowance should be made which will enable the men whose courage and foresight have accomplished so much to reap the benefits of their policies. That is, the existing stockholders deserve a chance to subscribe to the new securities before they are offered to the general public, and at a price per share somewhat below the market value of the stock outstanding at the time. If the stock is issued at its market value difficulties are often present in making the requisite volume of sales to meet the cost of the contemplated improvements. The allowance of a margin between the market and the issue value furnishes an incentive for existing holders of the securities to invest further in the property, and stimulates public interest in the matter in case the shares are in part sold later at auction. It seems only fair that those who have taken early risks in a property should receive an appropriate reward when the business reaches a highly profitable basis. This view is indorsed by conservative public-utility commissioners, the main question being the amount of reduction below the market value of the shares which is consistent with the public interest and at the same time fair to the existing stockholders in the property.

In a number of recent hearings before public-utility commissioners on petitions for approval of new stock issues this question has brought no little embarrassment to the companies asking for the right to issue stock, on account of their

failure to present to the reviewing tribunal a full statement of the manner in which the directors reached the price proposed for the new issue of shares. A prominent commissioner recently stated in such a hearing that this matter of determining a fair price for new issues is one of the most trying questions upon which his board has to pass. On an issue of stock of which the market value was, say, $250, with annual dividends of $10 per share, it follows that if the issue is sold at the market price a return of only four per cent results on the investment, and this is not an attractive rate of interest outside the field of savings-bank deposits and certain state or municipal securities. The new stock in the above case must be sold at a price of $200 per share to net a five per cent return, at $167 to net six per cent, and at $125 to net eight per cent. The fixing of the price postulates a consideration of what is a fair return in view of the degree of risk and the earning power of the property, and calls for a combination of financial, administrative and technical judgment of a high order. In a case like the one assumed above it is improbable that a conservative commission would object to the fixing of the price at above $200 per share, provided the bona fide sales had lately averaged $250. The value of the rights offered cannot be too large without inviting public attack, and as the fixed price is carried down toward par the return rises to rates which tend to arouse hostility, unjustified though the latter usually may be.

Without attempting to state what should be a fair price for a specific new public-utility stock issued under supervision of a state commission, it is important to realize that the basis of the determination, when such is decided by the directors, should as far as possible be made plain to the board sitting on the case. Too often the directors of the company fix the price in an off-hand way, and then appear at the hearings with no solid basis for their action. That such a basis generally exists is clear, and it should be presented for the reasonable consideration of the commission. Thus, a company whose stock has for some time sold at $150, and which returns $6 per share to the stockholders, may decide to issue new shares for a power-plant extension at a price of $100, on the theory that six per cent is by no means an unreasonable return on fresh money put into the enterprise. To secure the acceptance of a commission in such a case it is desirable to present the condition of the company before the board in a clear, straightforward manner, emphasizing all the existing grounds for the belief that six per cent is only a fair return in face of the exigencies confronting the property and in comparison with rewards of enterprise in other lines of industry. There is no question that if the officers of a petitioning company approach this problem with more definite figures and reasons for action than have often been exhibited in the past, a long step will be taken toward securing the confidence and the approval of the authorities and assuring a ready supply of capital.

CENTRAL-STATION OPPORTUNITIES IN BUILDING.

The possibilities of electricity in building and contracting are so well known that continued reference editorially to this subject may be superfluous, but it is believed that there are many points in this connection of which the central-station operator may take notice.

Every central station should keep informed of buildings in process of erection or about to be erected. In the latter case an active solicitation to the builders or contractors may secure the adoption of electric power for digging foundations, mixing mortar or concrete, hoisting material, illumination at night time, etc. In the case of buildings in course of erection, suggestions may be put forward to substitute electricity for steam power or manual labor in those operations to which it is easily applicable without a greatly increased capital expenditure. Advantage may be taken of breakdowns of existing prime movers to instal electric motors, or of labor disputes to substitute electrical operation which will call for fewer men.

In large cities like Chicago there are hundreds of homes being erected every year, built by the ultimate occupiers. Here is a great field for exploitation, and a greater one still for missionary work to popularize electricity in the home. Large central stations might find it worth while to equip a small contracting department with several electric shovels, cranes, mortar and concrete mixers, wood and metal saws, soldering irons, glue pots, etc., which it could loan, together with expert supervision, at a reasonable rate to small home-builders. The economy in building made possible by the use of these modern labor-saving devices, especially where several houses are being put up within a small radius, would undoubtedly pay for the installation of a temporary power line and perhaps yield a small profit besides. This latter, however, is not to be emphasized too strongly, and perhaps had better be reduced to a minimum or foregone altogether. The power line may be built quite substantially, however, if there is good reason to believe that it may be used by the tenant for electric heating and cooking.

Most central stations employ two rate schedules, one for lighting and a lower one for power, and electric cooking and heating are classified usually under the power rates. An added argument to persuade the builder-tenant to equip his house electrically would be to permit him to run everything except his lighting from the power line, thus including such conveniences as coffee percolators, toasters, flatirons, sewing and washing machines, fans, pumps, ozonizers, etc.

Thus the central station, in entering the thin edge of the wedge by aiding in building the house, should, by offering such reasonable inducements as outlined above, be able to secure a contract at the same time for wiring and fitting the premises for electricity, thus reducing the bill for these services by co-operating with the owner before and during the building operations.

PRESIDENT STILLWELL ON THE GOVERNMENT REGULATION OF WATER POWER.

One of the most noteworthy features of the annual convention of the American Institute of Electrical Engineers which at this writing is being held at Jefferson, N. H., was the presentation of the annual presidential address, an extended abstract of which is given in the report of the first day's proceedings on other pages of this issue. President L. B. Stillwell has been heard before on the subject of the conservation of water power, but never before has there been presented so clear and detailed an exposition of the defects of our Federal Government's regulations and how they should be modified to make it possible to develop the waterpower resources of our western states.

It has been frequently stated by engineers and others conversant with the economic considerations on which the present conservation movement is based, that the most comprehensive scheme for the conservation of our natural resources demands an early and general development of our waterpower resources in order to conserve our supply of fuel. President Stillwell shows that, while there is still considerable difference of opinion between the most radical conservation advocates and those seeking to make our water powers available for industrial use, there is hope of finding a common meeting ground relative to the government regulations respecting power sites on the public domain. In the main these regulations have been equitable; some of them, however, have placed so unreasonable a burden on those seeking to invest in waterpower projects that proper development has been unwisely curtailed. Extraordinary favoritism has been shown to those seeking to exploit the public coal lands, with the result of defeating the true conservation principle.

It is to be hoped that Mr. Stillwell's suggestions will be looked upon by the authorities in their true meaning. His constructive criticism shows that complete revolution of the government position is not necessary, but a reasonable modification of economic requirements of the problems is earnestly desired if the greatest good to the greatest number is to be attained.

TRANSPORTATION IN CHICAGO.

The impending traction consolidation in Chicago has caused several of the local newspapers some concern about the effect it will have on the transportation facilities in the city, especially as regards the elevated "loop" and the proposed subway system. The consensus of newspaper opinion appears to be that the "loop" should be abolished in order to permit the business area to expand and also to expedite the installation of a subway system similar to that of New York City. One writer sees in the proposed widening of the "loop" a setback to the subway scheme and a permanent throttling of Chicago's business district.

A little forethought and more mature reasoning, however, will incline one somewhat to an opposite opinion. There is no doubt but that the traction situation in Chicago calls for immediate and drastic changes. That these will soon materialize is evident from the consolidation scheme which is now being perfected. It is necessary that there should be a single and central responsible head for all the traction lines, so that there will be a uniformity and a conformity all around when relief proposals are being put into effect. The first measures will undoubtedly be palliative and therefore only temporary, and it would seem that the widening of the "loop" belongs to this category. Later, when the whole system can be put on a good business and paying basis, funds for subways can be more easily secured. The subways, then, would supplement, but not supplant, the elevated roads and the surface lines, and expansion of the business district would then take place automatically without any reference to the "loop."

The subways in New York are opening up new territory and are bringing with them a natural expansion. They do not supplant the elevated roads, nor will they for many years, if at all. And anyone who has watched the growth of transportation facilities in New York will predict the same for Chicago.

Add, furthermore, the electrification of the steam roads which lead into Chicago (and this in the natural course of events is bound soon to become an actual fact), and there will be no more congestion than what is bound to occur in any large city. But these things take time, and nothing will be gained by unduly harassing the men who are working out the problem.

THE ELECTRIFICATION OF TRUNK LINES.

On other pages of this issue there are printed abstracts of some very important papers which will be presented at the joint meeting of the Institution of Electrical Engineers of Great Britain and the American Society of Mechanical Engineers, in England during the latter part of July.

These papers deal with the electrification of trunk lines, and are contributed by men who are eminently qualified to discuss the subject.

The electrification of trunk lines, it appears, is no longer specifically an engineering or designing problem. Sufficient main-line track has been electrified to have demonstrated the reliability of the three great forms of electrical supply for the propulsion of vehicles, and the papers to which attention is called present in concrete form the advantages of each of these systems. These papers are worthy of very careful study as they present careful analysis of the fundamental engineering and economic conditions bearing upon the electrification of the main line, and it is from the points already evolved that further progress must be made.

CO-OPERATIVE ADVERTISING CAMPAIGN.

AN OFFER FROM THE LAMP MANUFACTURERS TO ASSIST CENTRAL STATIONS.

The member companies of the National Electric Lamp Association, the General Electric Company, the Westinghouse Lamp Company, and the Franklin Electric Manufacturing Company have joined in an advertising campaign to offer to the electric lighting industry a series of advertising campaigns which in breadth and scope quite out-distance anything of this sort on record.

The plan is a very simple one, but represents an unusual investment of money, time and labor. The campaigns are, for the most part, devoted to residence lighting, but touch on commercial and industrial lighting. They are so designed as to cover the great variety of central station conditions. Some fifty pieces of direct advertising in the form of booklets, folders, form letters, postal cards, etc., and about forty newspaper advertising designs have been collected. Every possible contingency in the way of peculiar local conditions has been provided for. In order to break away from any appearance of stock advertising, space has been left in the body of the copy for the signature of the central station company which is to distribute the matter. Certain space is also allowed for special propositions such as many central stations are offered on wiring contracts.

The thought in preparing this advertising was not so much to advertise a particular make of lamp as it was to boost electric lighting in general, and to plead earnestly for the whole cause of the central station. Several pieces for instance, are devoted largely to the wiring of old houses. Constant references are made to the advantages of having houses wired so as to make use of a flat-iron, vacuum cleaner, heating devices and electric appliances of all kinds.

In distributing this advertising, the plan to follow it out was that the advertising should not be distributed free of charge, because of the high cost, but that the central station should bear about one-fourth of the bare cost of printing. This will enable the central station, at an almost unreasonably low cost, to distribute the highest class of direct advertising. The lamp companies themselves have absorbed all the first cost, which includes the charges of advertising experts, expensive art work, color plates and unique designs. While this campaign is admittedly designed to increase the sale of incandescent lamps, still the broad gauge policy which conceived and executed the campaign might be stated in this manner: "The secret of increasing sales is to increase the market."

The lamp manufacturers have set about to increase the demand for electric light, understanding that every new socket requires another lamp. The central station which seizes the opportunity which this co-operative plan holds out to it will find that it will bring profit to the company through a method barely practiced before.

American Railway Master Mechanics' Association.

The forty-third annual convention of the American Railway Master Mechanics' Association was held in Atlantic City, N. J., June 20 to 23. As usual many of the delegates to the convention of the Master Car Builders' Association which had been held on June 15 to 17 remained over. The extensive exhibits of the supply men also were kept on view.

After an address of welcome by the mayor of Atlantic City and a response for the association by Eugene Chamberlain, President G. W. Wildin delivered the annual presidential address in which he advocated a centralized technical bureau in which the officers of the association would be associated in a consulting capacity. The reports of the secretary and treasurer were submitted and several other routine matters disposed of. The committee on mechanical stokers for locomotive use presented a report describing a number of these machines. W. C. Hayes then read a paper entitled "Education an Essential of Fuel Economy."

At the Tuesday session reports were submitted by the committees on widening the gauge of tracks at curves, steel locomotive tires, safety appliances and superheaters. Profs. C. H. Benjamin and L. E. Endsley, of Purdue University, presented a paper on "Locomotive Performance Under Different Degrees of Superheated Steam." H. T. Bentley read a paper on "Locomotive Frame Construction." The committees on safety valves and lumber specifications present reports.

On the concluding day of the convention Prof. Edward C. Schmidt, of the University of Illinois, read a paper on "The Relation of Freight Train Resistance to Average Car Weight." Reports were received from the committees on inspection of locomotive boilers, locomotive and shop operating costs, and consolidation of the Master Car Builders' Association and the Master Mechanics' Association. The latter subject was held over for a year. The election of officers for the ensuing year resulted in the choice of the following: President, C. E. Fuller; vice presidents, H. T. Bentley, D. F. Crawford and T. Rummy; treasurer, Dr. Angus Sinclair; executive committee, T. H. Curtis, F. F. Gaines and G. W. Wildin.

Light and Power Deal.

Application has been made to the New York Public Service Commission by the Poughkeepsie Light, Heat and Power Company, Newburgh Light, Heat and Power Company and Hudson Counties Gas and Electric Company for leave to consolidate under the name of the Central Hudson Gas and Electric Company. The companies operate in the counties of Dutchess, Ulster and Orange. The new company is to have a capital of $2,500,000 and the directors will be L. E. Perkins, J. W. Hinkley, A. G. Tobey, George A. Voorhees, of Poughkeepsie; Francis N. Bain, Hugh M. Buegler, Albert R. Beal, William R. Beal and Thaddeus R. Beal, of Newburgh, and John L. Wilkie and Ronald A. Davidson, of New York.

Michigan Lake Superior Power Company.

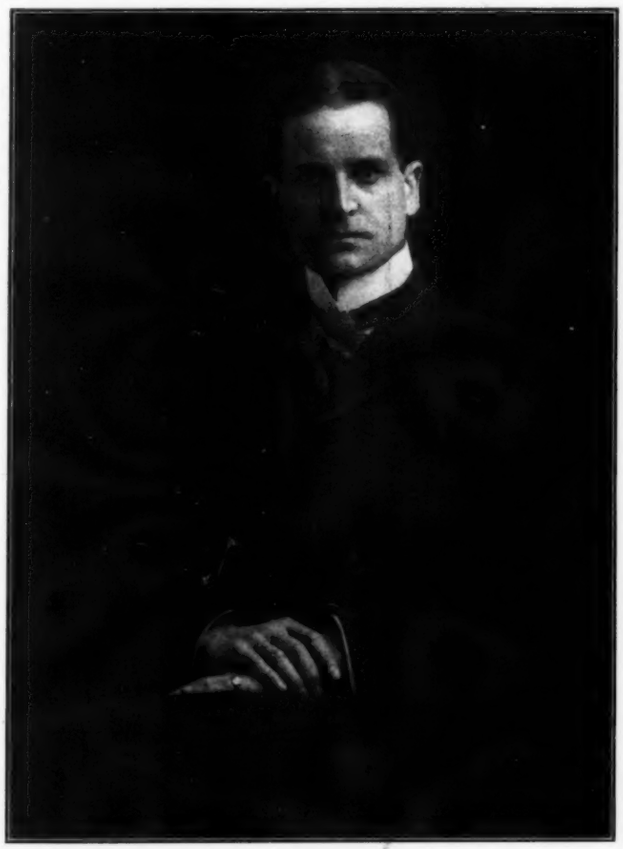
A tentative agreement subject to approval of trustees under the several mortgages, has been reached between the Michigan Lake Superior Power Company bondholders' committee, John Pitcairn, chairman, and the Lake Superior Corporation, for the adjustment of all differences covering prior lien claims, etc., held by the Lake Superior Corporation.

Commonwealth Edison Company Pays Dues to Chicago.

The Commonwealth Edison Company has recently paid the city $325,313 annual compensation for the year ending May 31 as follows: Three per cent of $10,824,469 derived from the sale of current, and ten per cent on $5,972 derived from rental of conduit space.

Robert T. Lozier.

The New York Electrical Society is one of the oldest organizations of its kind in the country. It has an active membership of about seven hundred and fifty, local to New York City. Among those who have had to work out the development of this organization there have been some of the most brilliant men in the electrical field. There is a pride of association and an atmosphere of good standing which makes this organization the delight of the leaders in electrical enterprise in the great metropolis. To the presidency of this association there has recently been elected one, Robert T. Lozier, and in the acquirement of this honor it may be assumed without any hesitation that he will mark up to the highest expectations of those most interested in the development of the institution. By temperament, by education, by experience and birth he is qualified to serve as a leader in this most interesting electrical community of interests.



ROBERT T. LOZIER,
President of the New York Electrical Society.

Robert T. Lozier was born at South Norwalk, Conn., in 1868. He started with Edison in 1883, and for thirteen years was in the various commercial and engineering departments of the old Edison company. He was in charge of the power house for Frank J. Sprague's demonstration of his electric motors on the Third Avenue railroad in 1886, and was with him in the early development of the Sprague motor. He returned to Mr. Edison at Llewellyn Park and helped in the building of the first multipolar generator of the annular ring type produced in this country. He was intimately connected with the development of the electric motor for individual drive, and later with the commercial production of gas engines and gas producers.

In 1896 he resigned as assistant manager of the lighting department of the Edison company and formed the firm of Warren & Lozier, later selling his interest in this concern to accept the position of eastern representative of the Bullock Electric Manufacturing company, later becoming its manager of sales. While with the Bullock company, with James Burke, he developed the "teaser" system of printing press control, which for a number of years was used by all the large dailies using electric drive. He has a number of patents on motor control to his credit, although none are in use at this time. Mr. Lozier was with the Bullock interests for eight years, and resigned to enter commercial and consulting engineering work, acting for some time as the New York representative of the Dodge & Day interests, and being now interested in the consolidating and financing of public utility properties.

He is a full member of the American Institute of Electrical Engineers, having served as manager during the 1902 and 1904 administrations, and has always been more or less active in its committee work. He was also active in developing the section form of organization of the Institute, organizing and serving as first chairman of the Cincinnati section. It will be remembered that he was the very efficient chairman of the great Public Service Dinner of the American Institute of Electrical Engineers, when in the time of financial distress which spread all over the country, the Institute held one of the most satisfactory and well-attended banquets in its history. He has since served the Institute in a like capacity with as great a degree of success. He is an affiliated member of the gas power section of the American Society of Mechanical Engineers, having assisted in building up its membership as chairman of the membership committee. He is a member of the Engineers Club, and was the second electrical engineer to join this organization, and has served for a number of years on its admission committee.

He was one of the organizers of the naval militia, and served as secretary of its veteran association. In addition to his engineering and commercial work he is greatly interested in literary work. He is a bachelor—that is, he is not married—yet. He has a large circle of friends and these will join with us in wishing him every success in the administration of his executive office as president of the New York Electrical Society.

Metropolitan Receivers' Certificates.

Judge Lacombe of the United States Circuit Court has signed an order granting Messrs. Joline and Robinson, as receivers of the Metropolitan Street Railway Company, New York, permission to issue receivers' certificates to the amount of $3,000,000 for the purpose of paying special franchise taxes amounting to about $3,750,000. The receivers have in hand at this date cash to the amount of $1,500,000. The special franchise tax receivers' certificates rank as a first lien on all the properties of the Metropolitan Street Railway Company, and take precedence of the mortgage of the Morton Trust Company, amounting to $16,500,000.

RELATION OF BOARD OF TRADE TO COMMERCE.

ADDRESS BEFORE CHICAGO ELECTRIC CLUB.

George Francis Stone, secretary Board of Trade, Chicago, Ill., delivered a very entertaining and instructive address on this subject at the regular weekly meeting of the Chicago Electric Club on Wednesday, June 23. Mr. Stone spoke at some length on the status of commerce showing its close relationship to the advancement of civization. He said that the history of commerce is the history of civilization and is closely identified with it in all of its advancements.

The predominating influence in commerce is, according to Mr. Stone, the boards of trade, which he said have been the sustaining elements through many adverses and hardships.

The Chicago Board of Trade was spoken of as a remarkable institution whose growth has kept pace with that of Chicago and the West. Established in 1848, the Board of Trade in 1909 handled approximately 263,000,000 bushels of grain and 15,000,000 head of cattle. These figures tend to prove that the board of trade is an institution contributing to the well-being of the world.

Speaking of the methods of transacting business, Mr. Stone said that buying and selling for future delivery provides the farmer with a positive market for his products at which he can obtain prevailing prices. He said further that this method affects all industries. Mr. Stone spoke fully in regard to being conservative in all transactions and gave several examples of conservative dealing on the board.

Preceding the address of Mr. Stone, it was announced that at least two of the meetings during July would be devoted to general debates, which, it is anticipated, will keep up the gratifying attendance during the warm weather which has marked the previous meetings of the club.

Telegraph Operators Inspect Tunnels.

In order to acquaint its employes with its improvements in and around New York City, the Pennsylvania Railroad is planning to run special trains to New York. A special party composed of division operators and others, in charge of J. C. Johnson, superintendent of telegraph, went on June 24 last through the station and tunnels.

The division operators, who have charge of the telegraph and telephone lines, were accompanied by their inspectors, repair foremen and train dispatchers. Their special train from Philadelphia arrived at Harrison about noon. After an inspection of the Harrison station the train ran to New York.

After luncheon at the Gregorian Hotel, in West Thirty-fifth Street, the party made an inspection of the station and went through the East River Tunnels to Sunnyside Yard.

Telephone Publications.

A number of the telephone companies throughout the country are publishing monthly papers for distribution to their various exchange managers and other employes, with a view to benefiting the service. These publications are full of local information of value to the telephone operating force, and are capably and understandingly edited. They do not carry advertising, but are devoted exclusively to matters of local interest

The following is a list of the publications, as far as known to the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, making seventeen in all:

The Telephone News, The Bell Telephone Company of Pennsylvania, Philadelphia, Pa.

Central Union News, Central Union Telephone Company, Indianapolis, Ind.

Michigan State Gazette, Michigan State Telephone Company, Detroit, Mich.

Wisconsin Telephone News, Wisconsin Telephone Company, Milwaukee, Wis.

Cumberland Telephone Journal, Cumberland Telephone and Telegraph Company, Nashville, Tenn.

The Monthly Bulletin, Pioneer Telephone and Telegraph Company, Oklahoma City, Okla.

Cleveland Telephone News, The Cleveland Telephone Company, Cleveland, O.

The Pacific Telephone Magazine, The Pacific Telephone and Telegraph Company, San Francisco, Cal.

Telephone Gazette, The Bell Telephone Company of Canada, Montreal, Canada.

Operating Bulletin, Chicago Telephone Company, Chicago, Ill.

New England Telephone Topics, New England Telephone and Telegraph Company, Boston, Mass.

Southwestern Telephone News, Southwestern Telegraph and Telephone Company, Dallas, Texas.

Telephone Bulletin, Southern New England Telephone Company, New Haven, Conn.

The Efficiency Bulletin, Corn Belt Telephone Company, Waterloo, Iowa.

Rocky Mountain Bell Telephone News, Rocky Mountain Bell Telephone Company, Salt Lake City, Utah.

The Telephone Review, New York Telephone Company, New York, N. Y.

The Transmitter, Colorado Telephone Company, Denver, Colo.

Society for the Promotion of Engineering Education.

The eighteenth annual meeting of the Society for the Promotion of Engineering Education was held at the University of Wisconsin, Madison, Wis., June 23, 24 and 25. The members were welcomed by President Van Hise of the University of Wisconsin, who expressed the hope that the society would take action towards raising the requirements for graduation in harmony with the requirements of other professional schools, which insist on two years' work in arts and sciences as a preparation.

The presidential address of Prof. Henry S. Munoe opened a discussion on efficiency in engineering education, which was participated in by many speakers. A symposium on the teaching of mathematics to students of engineering was based largely on the voluminous report of the committee on that subject. Two other committee reports that elicited much discussion were those of the committees on engineering degrees and on entrance requirements. The report of the latter was referred back for further consideration.

Among the large number of papers presented before the meeting were: "The Harvard Plan" by Dean W. C. Sabine; "Technical Education in Germany" (two papers) by Dean G. H. Shepard and by Frank Koester; "The Recent Inspection Tour of the Ohio University Students" by Prof. W. T. Magruder; "Technical Education in China" by Prof. W. H. Adams; "Inspection Trips for Technical Students" by Prof. G. C. Shaad; "The Teaching of Judgement" by E. J. Kunze; "Character Training" by Dean J. P. Jackson.

Electricity Supply in Dundee, Scotland.—I.

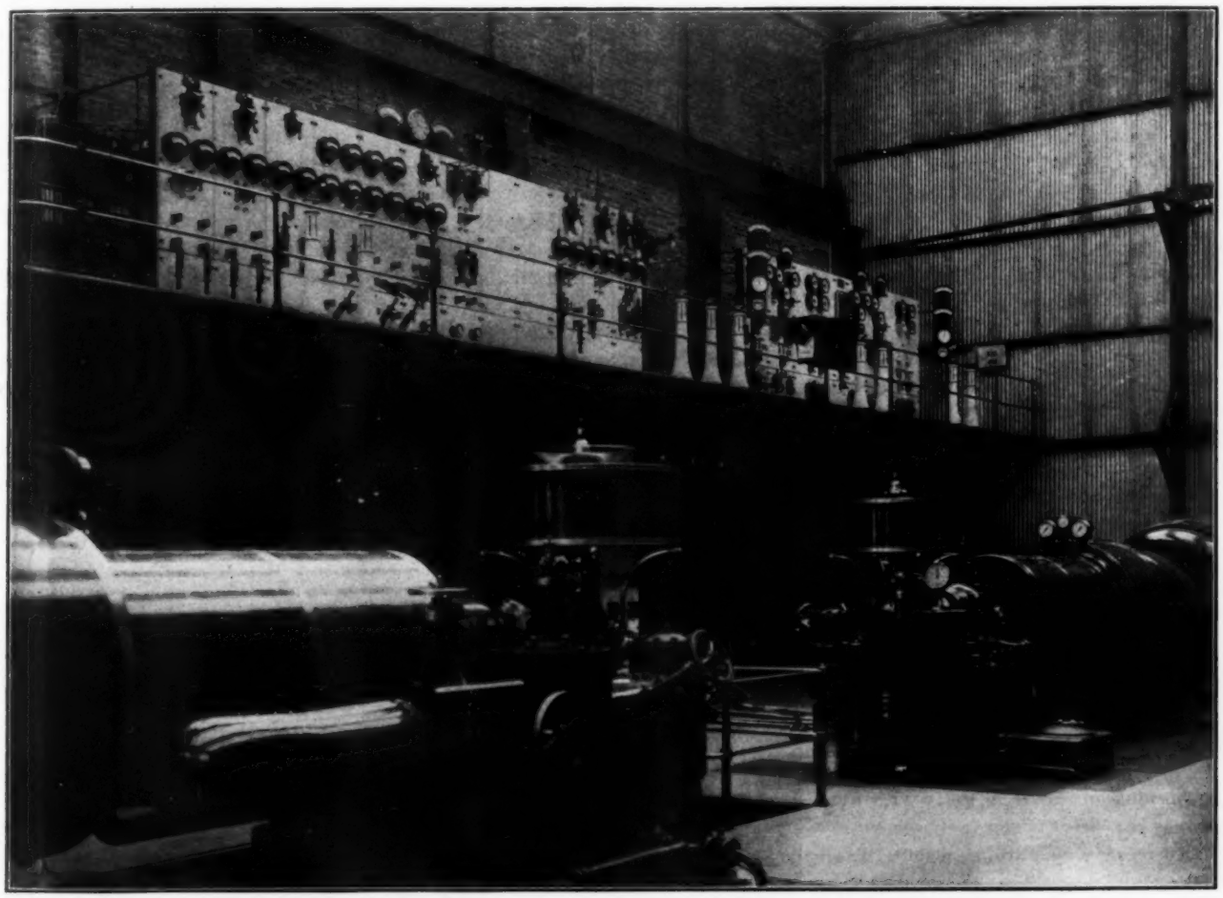
An Illustrated Account of the New High-Tension System.

BY ROBERT L. REID.

The new extra-high-tension system laid down by the City of Dundee, Scotland, to the designs of H. Richardson, the city electrical and tramways engineer, is worthy of attention, as it embodies to a great extent the most up-to-date British practice in the layout and design of generating stations, as well as in the distribution of electrical energy.

The river Tay at Dundee is spanned by a railroad bridge fully two miles long leading into a district where there is an abundant supply of coal. The British Admiralty has lately formed a submarine base at Dundee, and a large flotilla of the "C" type of submarines along with the parent cruiser *Vulcan* and a number of destroyers have now their headquarters there. A portion of area of about 320 acres. A low-tension generating station was built near the center of the city, generating direct current at 200 volts and distributing on the three-wire system, giving 100 volts at the consumers' terminals.

Owing partly to the inherent conservatism of the town, even although in 1897 the area of supply was made that of the burgh, progress was very slow



ENGINE ROOM, CAROLINA PORT STATION, SHOWING TURBINES AND CONTROL BOARDS.

The City of Dundee, with a population of 170,000 inhabitants and an area of 4,881 acres, is the third city in Scotland. It is primarily an industrial city and is the center of the jute industry in Great Britain, importing, roughly, about 220,000 tons of jute annually. There are about 100 mills and factories within the city, having an aggregate horsepower of approximately 60,000. the harbor and docks has been leased by the Admiralty for a repairing depot, etc. There are also a number of engineering works as well as shipbuilding yards which provide employment for a large portion of the inhabitants.

Dundee was one of the first cities in Great Britain to adopt the supply of electrical energy. In 1893 the corporation commenced the supply in a small up till 1900. In this latter year the corporation took over the horse and steam tramways of the city from the local operating company, and after some discussion decided to electrify the whole system. This was gradually accomplished and the lines greatly extended till at the present time there is a length of route open to traffic amounting to fourteen and one-half miles.

The price charged to the tramway department for current has been steadily reduced from three cents to two and one-quarter cents per kilowatt-hour, which charge is inclusive of the cost of upkeep of the overhead equipment and cables. Large extensions were made to the power station to take this extra load and also to provide for the increasing demand for power and lighting from private consumers.

The present chief engineer upon taking up his duties in 1903 practically remodeled the works and changed over the lighting system from 100 to 200 volts, thereby greatly increasing the capacity of the feeders. Notwithstanding all the improvements which had been made, however, the business increased within recent years to such an extent, and the plant became so fully loaded, that serious attention had to be given to still further large extensions. At the same time the disadvantages of a site far removed from both rail and water, together with the want of elasticity in the system of generation and distribution, became more and more evident, when large powers had to be supplied over the larger area.

Reports and estimates were submitted by Mr. Richardson, who advised the adoption of an extra-high-tension system with a new generating station situated in a more favorable situation, together with substations. The council, after consultation with J. F. C. Snell, of London, who practically corroborated the resident engineer's reports, proceeded with the work, placing the responsibility for the design and execution of the whole system in the hands of the city electrical engineer.

In December, 1907, the building was commenced of an extra-high-tension, three-phase station for generating alternating current at 6,600 volts with a frequency of fifty cycles per second, and also three substations where the current could be converted to direct current and fed into the low-tension systems.

The new system has cost about $500,000, and has been in operation since July last year, proving satisfactory in every way. The official inauguration of the system took place on February 23, 1910, when the generating station was opened by Prof. J. A. Ewing, Director of Naval Education to the British Admiralty.

The site selected for the new works is at Carolina Port, about one and one-half miles east from the center of the city, and some 190 yards north from the river Tay. It has an area of roughly one acre, but there is ample room in the vicinity for extensions. Being close to the river there is a plentiful supply of water for condensing purposes, while a short private railway siding connects to the harbor branch railway leased by the Dundee and Arbroath Joint Railway Company, and provides facilities for the cheap transport of coal.

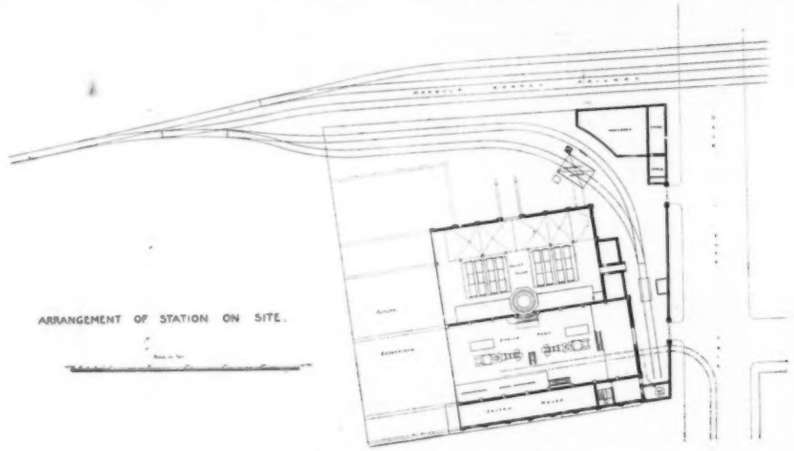
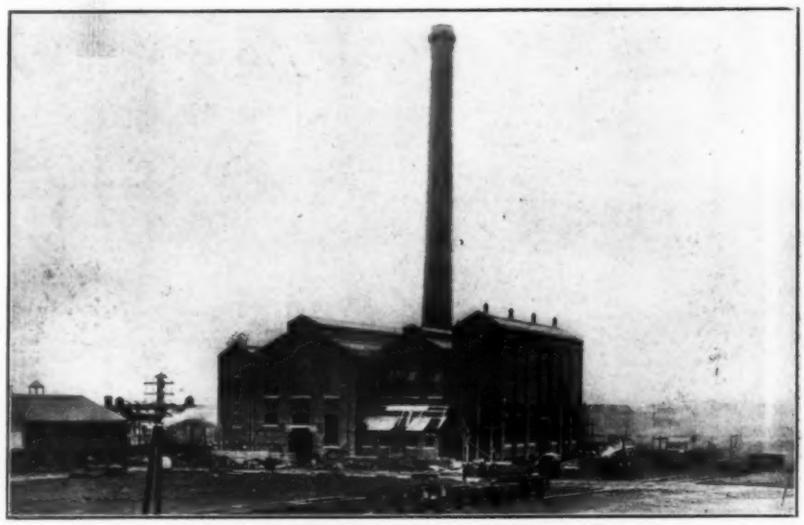


DIAGRAM OF STATION AND SITE.

The chief disadvantage of the site was the nature of the ground, which necessitated the greatest care being taken with the foundations. The ground, which was reclaimed from the river some twenty years ago, consists chiefly of gasworks refuse, and was wholly unsuitable for carrying heavy loads. Trial borings were made and showed good rock at a distance of from thirty to thirty-three feet below the surface. After considerable discussion on the subject it was agreed to adopt the pile-and-raft form of foundation, and, considering the corrosive nature of the soil, reinforced concrete was chosen as the material to be used. Fully 300 reinforced concrete piles of fourteen inches diameter were driven to the rock and a reinforced concrete raft, varying from four and one-half inches to four feet thick, was constructed over the heads of the piles. This raft forms the basement and lower floor levels of the station.

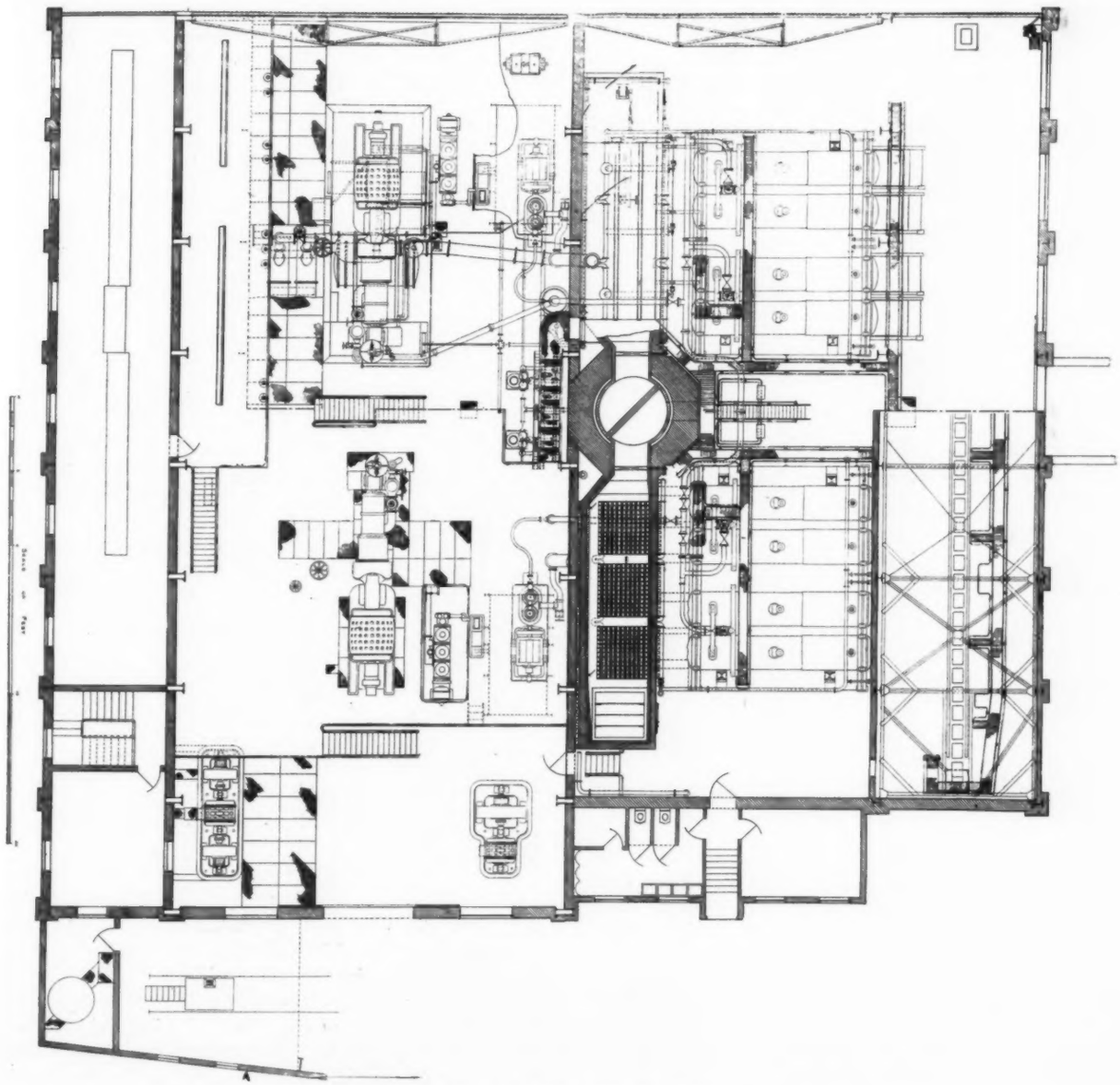


EXTERIOR VIEW OF CAROLINA PORT STATION.

BUILDINGS.

The general arrangement and details of the buildings may be seen from the illustrations. The main building, which averages 120 feet long by 130 feet wide, may be said to consist of four parallel bays devoted to coal-stor-

age and coal-handling plant, boilers, turbo-generators and extra-high-tension switchgear respectively. The structure consists of a steel framework for supporting the heavy weights, filled in with light brickwork on three elevations, and has corrugated iron on the fourth to allow for easy extensions. dressing-rooms and lavatories conduces to the most healthy working conditions of the staff and workmen. With the exception of the roof practically no wood is used in the construction, the whole of the window frames and practically all the doors and stairs being of iron or steel.



PLAN OF CAROLINA PORT STATION.

The brickwork is of red pressed brick with large windows on the north and east elevations. The roofs are of blue slate nailed to wood boarding and have large roof-lights running the whole length of the building. The amount of light arranged for all over the works is quite a distinctive feature of the design, and along with the first-class

COAL HANDLING.

Coal is brought to the site in railway wagons at the average level of the ground. A small electric locomotive is employed for shunting and takes its current from overhead wires by two trolley arms. The locomotive, which has two motors, is capable of pulling a load of twenty tons up an incline of one in sixty at six and one-half miles per hour. The wagons, after being weighed in a weighing machine capable of taking twenty tons, are pushed one at a time into a revolving ring tippler, which turns the wagons completely over and empties the coal into a receiving hopper underneath. The tippler is driven through worm gearing from a four-brake-horsepower electric motor situated in a pit and controlled from a control house at the side of the tippler. The time taken to make a complete revolution is two minutes. The rings are weighted at the top to give a central center of gravity when turning with a wagon, and a lock on the rails prevents

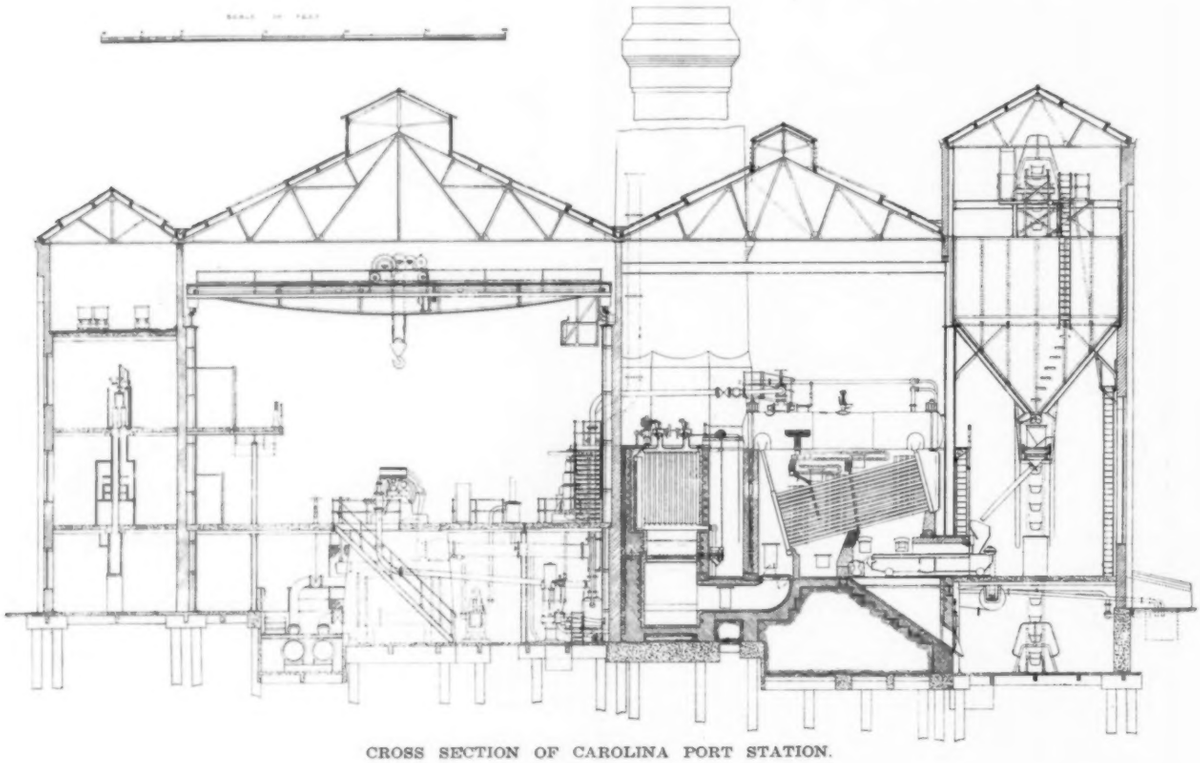
the rings being turned without a wagon in position. The hopper underneath the tippler is built of steel plates three-eighths of an inch thick, stiffened by tees and angles and supported on piles. It has a capacity of eighteen tons, and there is a sliding valve at the bottom which regulates the flow of coal to the tray conveyor. The tray conveyor carries the coal from the hopper to the main conveyor, a distance of about forty-five feet; it is driven by a two-brake-horsepower electric motor and is controlled either from the tippler control house or the ash basement. The main conveyor, which lifts the coal up to the overhead bunker, is of the gravity-bucket type, and is fed from the tray conveyor by means of a rotary filler driven by the conveyor chain. The filler, which feeds the buckets while they are in motion, regulates the quantity of coal for each and prevents the coal being split between them. The main conveyor is driven by a six-brake-horsepower electric motor by means of an ingenious push arrangement of pawls gearing with the links of the chain. The conveyor is about 326 feet long and has a vertical lift of sixty-two feet and travels at the rate of fifty feet per minute. The buckets are designed to be easily cleaned, being each stamped out of a single piece of steel, and have only the side tipping lugs riveted on. The buckets may be made to discharge the coal into any bunker by means of adjustable tipping levers. It is arranged that the conveyor can only be started from the top level, but may be stopped from either the top, firing, or basement floors.

BUNKER HOUSE.

The bunker house is 105 feet long by twenty feet wide and is sixty-five feet high from the ash-basement level to the eaves. The firing floor is twelve feet above the ash-basement level and is four feet above the ground. This allows for windows to give light and ventilation to the ash-basement. An inclined roadway at the north door allows for easy access for carting coal onto the firing floor should the coal-handling plant break down, as well as for the handling of boiler-house material.

Above the firing floor are the coal bunkers with a capacity of about 700 tons. They are entirely built of steel plates stiffened with tees, joists and angles. These bunkers weigh about sixty-seven tons, and contain about 8,300 rivets. The bottoms are three-eighths of an inch thick, while the sides and bulkheads are five-sixteenths of an inch in thickness. Very special attention was paid to the riveting, so that the bunkers might be, as far as possible, watertight.

The easternmost bunker is reserved for ashes, special paint being used to preserve the steel. Coal is withdrawn for use through valves at the bottom of the bunkers and passes through measuring machines where the amount is registered, then by way of chutes to the stoker hoppers. The measuring machines run on rails suspended from the bunkers and coal may be taken from any bunker to any boiler.



CROSS SECTION OF CAROLINA PORT STATION.

BOILER HOUSE.

The boiler house is 105 feet long by forty feet wide, and fifty-three feet nine inches from the basement level to the eaves. Provision in height has been left for thermal storage should conditions warrant the adoption of this in the future.

There are at present four Babcock & Wilcox water-tube boilers each having a heating surface of 6,182 square feet and rated to evaporate 20,000 pounds of water per hour at a pressure of 180 pounds per square inch. Each boiler is fitted with a Babcock & Wilcox improved superheater to give 150 degrees Fahrenheit superheat, and the superheaters have the usual flooding and

draining arrangements. The boilers are arranged in batteries of two and the brickwork settings are faced with white enameled bricks to prevent the infiltration of air and loss of heat. The walls of the boilers are built on the hollow-wall principle and the spaces between the walls are filled with slag wool.

The boilers are each fitted with two chain-grate stokers having a total grate area of 120 square feet. The stokers are specially designed to burn the cheapest fuel. They are driven by means of chains from a main shaft situated in the ash basement.

BOILER HOUSE, CAROLINA PORT STATION.

The electric driving motors are placed in the basement between the batteries of boilers, but are controlled from the firing floor. There are two motors of eight brake-horsepower each, and each is capable of driving the eight stokers. The ashes descend through dumping doors at the back of the chain grates to the ash pits underneath and from there to the basement, where, after being cooled, they are elevated by the main conveyor to the ash bunker. They are discharged from the ash bunker by chutes either into railway wagons or to carts. Behind the batteries of boilers are situated two economizers of 360 tubes each, one on either side of the chimney and above the main flues. When the economizers are not in use, the flue discharges direct to the chimney. The economizers raise the temperature of the feed water about ninety degrees Fahrenheit. Owing to the intention of burning the cheapest fuel, special arrangements had to be made for cleaning both the economizers and the flues. Under each section of the economizer the soot pit is formed with a double slope leading to a trough, where a screw conveyor is placed and may be made to discharge the soot into trucks. The screw conveyors are driven through worm gearing from a horizontal shaft, which can be worked from the scraper gearing when desired. Care was taken in the design and construction of the flues to have them as short as possible, with large curves and rounded corners. All the dampers are of the horizontal butterfly type. The economizer scraper gear is driven by a four-brake-horsepower electric motor situated at the economizer top level. Babcock & Wilcox, of Renfrew, were the contractors for the whole of the boiler-house plant, including the coal and ash-handling apparatus.

CHIMNEY.

Near the center of the buildings is the one chimney, which is nine feet internal diameter and 200 feet high. It rests on a reinforced concrete foundation four feet thick and is supported by twenty-five piles. The chimney is built of red brick and has a fire-brick lining and center division inside, to a height of twenty-six feet above the firing level.

STEAM PIPING.

The steam piping is designed to be as simple and as short as possible. There is an eight-inch header in the boiler house, to which each boiler is connected by a six-inch branch pipe. From the main header two eight-inch pipes lead over to the steam separators situated on the engine-room lower floor. Two eight-inch branches lead from the separators to the turbines.

Special attention was given to the draining of the steam pipes, the whole of which drain towards the separators, there being only two steam traps in the works, one at each separator.

The main and branch steam-pipes are of mild steel, with branches and flanges riveted on. The main header is securely anchored at two points, in the middle of each battery of boilers, and there is a horizontal expansion bend between the batteries. In fixing the pipes this expansion bend was stretched cold by an amount equal to half the amount it would be compressed by the expansion when working. All the pipes where possible are supported from below and

rest upon rollers to give free movement for expansion.

The boiler house is fitted with a Simmance-Abady carbon-dioxide and draft recorder, which can be connected to any boiler or flue. A large steam-pressure gauge with an illuminated dial gives the steam pressure in the main steam pipe, and there is also a recording steam-pressure gauge.

ENGINE ROOM.

The engine room is 120 feet long by fifty feet one and one-half inches wide, and forty-nine feet nine inches high from the lower floor level to the eaves. The upper floor is fourteen feet nine inches above the lower floor and is constructed of reinforced concrete on the Columbian system, and finished with red Terrano. Large open wells are left in the upper floor, besides lifting checker-plates, to allow of the overhead crane, being used when overhauling the auxiliary plant below.

As appears in the plan (p. 9), the upper floor is cut short at the east end and the part of the lower floor at that end reserved for substation machinery.

Contrary to usual power-station practice, the feed pumps are placed in the engine room on the lower floor. There are two steam-driven Weir feed-pumps each capable of delivering 80,000 pounds of water per hour against the boiler pressure of 180 pounds per square inch.

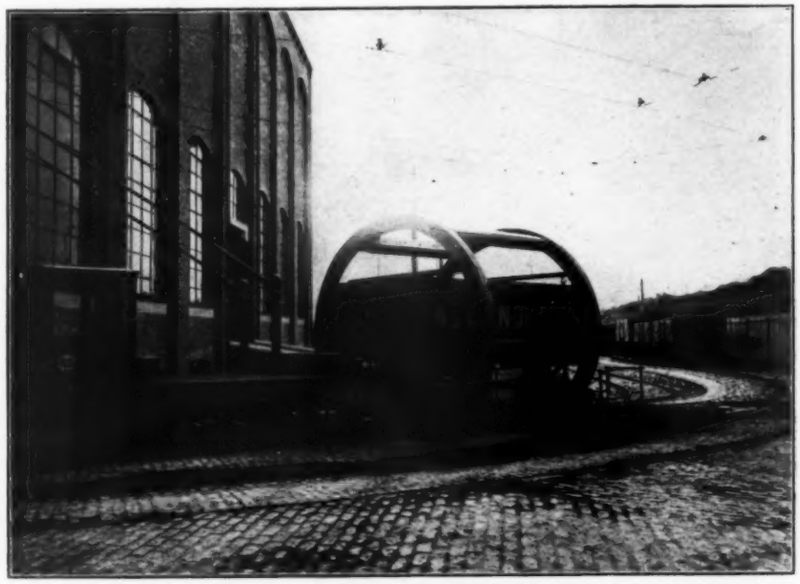
Besides the ordinary stop valve on the pump there is a regulating valve, with a long spindle extending through the brickwork of the chimney into the boiler house, by means of which the firemen can regulate the speed of the pump. This regulating valve is designed so that it does not cut off the steam altogether, and thus allows the pump to be always in working condition. Above the wheel on the long spindle in the boiler house is a gauge giving the pressure of the feed water in the feed pipes, and on this gauge the strokes of the pump can be plainly observed.

The exhaust from the cylinders of the feed pump, owing to the presence of oil, is not allowed to mix with the turbine exhaust, but is passed through a coil in the hot wells, where it is used to heat the feed water, and the condensed steam is then run to the drains. The whole of the feed piping is of mild steel, with flanges screwed on and pipes expanded. All flanges on all pipes are to the British Engineering Standards with mild-steel haxagonal-headed bolts.

GENERATING SETS.

There are two steam turbines coupled direct to two alternators. Each set has a capacity of 2,000 kilowatts, but is capable of dealing with an overload of twenty-five per cent for two hours, and fifty per cent for half an hour. The turbines are of the Willans-Parsons type, now so well known that they hardly call for any special remarks. The most important feature, perhaps, is the system of blading, each blade being fitted into a slotted ring at the inner end, while the outer end is riveted into a shrouding ring of channel section. This method of assembling the blading, besides adding to the strength, greatly reduces the risk of stripping. The sections of blading are made up in half rings both for the casing and rotor, and these rings are held in position in dovetailed grooves by means of calking strips. On each turbine there is a hand-operated overload valve, which admits high-pressure steam to the second expansion rings. The governor is of the centrifugal type and acts directly on the throttle valve. It is also fitted with electrical control and may be controlled from the switchboard. Forced lubrication is used. There is also a small hand oil pump provided to flush the bearings before starting. The turbines are further provided with a pressure gauge, vacuum gauge, and tachometer.

(To be continued.)



LOCOMOTIVE AND TIPPLER.

New York Rapid Transit Law Changes.

Three bills amending the New York city rapid transit law were signed by Governor Hughes at Albany, last week. One by A. E. Smith permits the city to reserve the right to authorize the use of a railroad constructed under the rapid transit law by others than the contractors or constructors of the road. A second by Mr. Lee eliminates from the law the provision prohibiting the construction of a rapid transit road on Nostrand avenue, Brooklyn, south of the Eastern Parkway. The third by Senator Frawley, permits a railroad corporation which has instituted condemnation proceedings for the acquisition of property for the construction of additional tracks of an existing elevated railroad and facilities in connection therewith to enter immediately upon the property to be taken and to devote it temporarily to the use sought.

Copper Exports.

Exports of copper for the week ended June 23 were 4,580 tons. Since June 1 they were 15,158 tons, compared with 29,027 tons the same period last year.

The street cars of Munich, Germany, were put out of service on May 22 by a fire in the powerhouse. The fire was caused by a short circuit in a defective cable, the cable having been punctured from a lightning discharge. The loss is estimated at $100,000, fully covered by insurance.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

OPENING OF THE ANNUAL CONVENTION AT JEFFERSON, N. H.

Special dispatch to the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

JEFFERSON, N. H., JUNE 29.—The twenty-seventh annual convention of the American Institute of Electrical Engineers was opened auspiciously yesterday. The attractive surroundings of the Waumbek, where the Institute headquarters are located, along with the beautiful view from the hotel and the bracing atmosphere characteristic of the White Mountains, lent much enthusiasm to the opening proceedings. From the lively character of the discussions on the first day it is evident that great interest will be taken in all the papers presented. The registration for the first day was 140, but a much larger attendance is expected before the close of the meeting on July 1.

President L. B. Stillwell called the first session to order at 2:30 o'clock yesterday afternoon. Secretary R. W. Pope made a number of announcements chiefly relative to the programme of entertainments and read regrets at their inability to be present from Past-Presidents Louis A. Ferguson and Elihu Thomson. Mr. Stillwell then read his presidential address, an extended abstract of which follows:

CONSERVATION OF WATER POWERS.

True conservation of our natural resources means wise utilization of those resources without unnecessary waste. Such utilization is the primary and essential business of the engineer. During the last twenty-five years, a period practically coterminous with the life of this Institute to date, the art of transmitting power by electricity has grown from a laboratory experiment into a development universally recognized as one of the great factors of industrial and commercial life. A very large proportion of the water powers hitherto unappropriated are either located upon government lands or are dependent, wholly or in part, upon the run-off from government lands. The regulations established by national and state governments which control or affect the further utilization of water powers, therefore, are of peculiar concern to the members of this Institute. A bill indorsed by the administration is now before Congress which, if passed, will confer definitely upon the President and his executive assistants full authority in respect of withdrawal of public lands and unappropriated water powers. The present occasion seems opportune for the presentation of a brief and non-technical discussion of the practical bearing and effect of existing laws governing the appropriation of water powers located on public lands, which, as now construed and applied, are seriously retarding the utilization of these powers. Present practice, whether ideal or faulty, is more likely to be modified than revolutionized, and now is the time for unprejudiced and candid discussion of the regulations now in force.

The Relation of Forests and Stream Flow.—The Bureau of Forestry has established regulations governing the appropriation of water powers located on streams which drain watersheds included in whole or in part in forest reserves. Among these regulations is the imposition of a graduated rental, to be paid by the individual or corporation appropriating the water power and used by the government for forest purposes. This rental rests upon the assumption that the appropriator of the power will be benefited by the preservation of the forest, and this idea is accepted generally by engineers and by the public. During the last two years, the question of the actual or assumed effect of forests on the watershed in regulating the run-off, has been widely debated. That forest cover controls the run-off to a material extent has been vigorously asserted by engineers prominent in the government service and by many others, and on the other hand, it has been seriously questioned by a number of our leading engineers. As regards that forest control which is practically related to the commercial value of water powers, the author believes the following to be a correct statement: While the aggregate annual run-off of our rivers in general depends upon the total annual precipitation, the presence of forest cover on the watershed regulates the rate of run-off to an extent which in many cases materially affects the value of the water power, this regulation tending to equalize the flow and prolong it during the dry season.

With this understanding of the essential physical facts which are pertinent, it is proposed in this paper (1) to discuss briefly certain provisions included in the present regulations of the Forest Service governing the appropriation of water powers dependent in whole or in part upon forest reserves, and (2) to suggest the outline of a plan which to the author appears preferable to that now in force.

The present form of permit provides a nominal charge (rental) for the land occupied by power house, dam, canals, penstocks, flumes, etc., the rate being "One dollar per acre and five dollars per mile for the land occupied by said works." It provides also that "the gross operation charge for any year shall be calculated by the forester upon the basis of the quantity of electric energy generated in such year at a maximum rate, * * * *" which amount progressively increases up to the fiftieth year. The maximum rates are applicable only in cases where all the water utilized comes from the forest reserve and the entire head developed results from the topography of the forest. In all other cases, deductions are made.

The Imposed Rates as a Tax on the Power Enterprises.—The proposed conservation charge, at least during the early years of the contract, cannot be regarded reasonably as constituting any very serious financial burden imposed upon the individual or corporation developing the water power. If power be sold at an average price of one cent per kilowatt-hour, the maximum conservation charge during the first five years of operation is equivalent to a tax of 0.61 per cent of gross receipts. During the next five-year period, it is increased to 1.25 per cent and it increases gradually from this figure to a maximum of 3.25 per cent of gross receipts, which rate applies during the last five years of the fifty-year life of the contract. The average charge during the fifty-year period is 2.086 per cent of gross receipts. It is a fair question, however, whether a more rational method, and one which in certain important respects would tend to produce better results, might not be devised. The plan in force obviously is open to several objections. Among these are: (1) The imposition of a tax upon output means that the man who installs a highly efficient plant is called upon to pay a higher conservation charge than the man who wastes water by the installation of a cheap and inefficient plant. (2) The proposed method of charging imposes a heavier burden upon the man who sells his power at a low price than upon him who sells it at a high price. (3) Under the plan proposed by the Forest Service the man who takes his power to a market, say 100 to 300 miles away, must pay to the government for the losses incurred in doing so and pays more than the man who sells to the home market. While the method of applying the conservation charge has been criticised in many quarters and while the objections above pointed out are valid, the method in force possesses undoubted advantage in the fact that it is definite and readily determined by reference to records which the permittee can readily keep. The charges, moreover, are adjusted to encourage development of the water powers by recognizing the fact that few, if any, can earn interest on the necessary investment from the start. Except by reducing the average charge for the period, it would be difficult to devise a plan less onerous for the permittee. (4) While the imposed charge could not be regarded as excessive, if the power developed were entirely, or even very largely, dependent upon the preservation of forest cover upon the watershed, it represents a high rate when measured in a comparison with the increase in commercial value of the power, which, under ordinary conditions, is due to the forest. (5) The tax is imposed upon power from all forest reserve lands, regardless of the actual condition of the forest upon which it is based. Obviously, therefore, a uniform tax must be very much heavier in some cases than in others, as compared with the benefit upon which it theoretically rests. (6) It tends to retard utilization of water powers and stimulates the use of coal for power purposes—a result which is in direct contravention of the primary object of conservation. (7) Something less than one-half the public domain is included within the limits of the forest reserves. To secure maximum revenue and to minimize the average retarding effect upon utilization of these water powers resulting from a system of rental, any charges which may be imposed by the Federal Government upon waterpower appropriation should apply to all public lands.

The author has expressed the opinion that the imposed charge would not be regarded as excessive if the power developed were entirely, or even very largely dependent upon the preservation of forest cover upon the watershed. In his judgment, however, that effect has been very greatly exaggerated by the majority of writers who have endeavored to instruct the public regarding the subject. The extent to which forest cover and other surface conditions, which tend to regulate run-off, succeed in equalizing stream flow was illustrated by President Stillwell in a tabulated statement showing in the case of ten fairly representative rivers of the Atlantic and Pacific slopes the maximum, average and minimum run-off in second feet per square mile for periods of five consecutive years and the minimum run-off expressed in percentage of maximum run-off and in percentage of average run-off. In no case does existing forest cover or any other surface condition effectively equalize the flow.

The effect of forest cover in adding to the commercial value of a water power, results from two facts, first, that an increase in minimum run-off reduces the necessary investment in auxiliary steam or other power plant, second, that some portion of the flood waters, which otherwise would flow past the power plant, at a time when the

water available exceeds the amount needed, is held back long enough to permit its commercial utilization.

Features of the Present Regulation Which Should Be Changed.—Clause 15 of the power agreement now in force reads as follows: "The permit here applied for shall be nontransferable and shall be subject to all prior valid claims which are not by law subject thereto." The aim in view, of course, is to avoid monopoly, as a result of which an artificial price might be maintained higher than the average which would be fixed by competition of similar developments in the same market. If effective, it is obvious that this requirement must retard development. The economic reasons which demand that water powers on the same stream should deliver their output to the same network of distributing circuits in many cases are material, and those which demand that the output of developments on different streams should be similarly combined are even more weighty. By electrically combining the output of a considerable number of water powers, interruptions of service, due to accidents to flumes or to transmission circuits, are decreased. The clause should be modified by permitting transfer, subject to approval by the government.

Continuous Operation of Plant.—Clause 18 reads as follows: "The permittee shall, except when prevented by the act of God or the public enemy, or by unavoidable accidents or contingencies, continuously operate for the generation of electric energy, the works to be construed under the permit hereby applied for, in such manner as to generate after such generation begins," not less than certain percentages of the full hydraulic capacity of the works measured in kilowatt-hours. The object in view is to prevent a power company increasing its prices by creating an artificial power famine and to secure full utilization of the available power. Some permits have specified that not less than twenty-five per cent of the full hydraulic capacity must be generated; others as much as seventy-five per cent, depending upon special circumstances supposed to govern the case. In many cases this clause presents serious difficulty to the power company. If it be necessary to retain such a clause, it should be accompanied by a provision permitting, with the consent of the government, a reduction in the percentages originally fixed.

Term of Permit.—Clause 20 of the permit in force reads as follows: "The permit hereby applied for shall cease and be void, upon the expiration of fifty years from the date of approval hereof, but it may then be renewed in the discretion of the duly authorized officer or agent of the United States, and upon such conditions as he may in his discretion fix. * * * *" This clause contains no provision for taking care of the contracts which may be in force between the permittee (or his successor) and his customers at the expiration of the fifty-year period. It is obvious that by its absence the value of the permit during the latter years of its life, is materially impaired. Power contracts are frequently, in fact generally, executed for periods of not less than five years and frequently for ten or even twenty years. The contract agreement should include a clause guaranteeing for a period not less than five years subsequent to its termination, the fulfillment of contracts between the permittee and customers existing at that time.

The Permit Revocable.—Under the law as it now stands the Forest Service can grant to an individual or corporation seeking to develop water power from forest reserves only a permit revocable by the Secretary of Agriculture in his discretion. No argument is necessary to demonstrate that a permit revocable in the discretion of the head of a department is not an adequate basis for financing an enterprise requiring investment of capital.

An Alternative Plan.—Assuming that upon careful consideration the American people should decide to impose a tax upon natural resources of the public domain, to be used in conserving and developing those resources, it is perhaps not improper to suggest the outlines of a plan which from the standpoint of public policy appears preferable to that now in force. The essential features of the plan which Mr. Stillwell suggests are the following:

(1) A tax imposed on all sources of power found upon public lands—a royalty on coal mined and a rental upon water power. The charge for water power to be based not upon an indefinite and disputed relation of forest covering and commercial value of the power, but upon the fact that the government needs revenue to develop and conserve our natural resources, owns the power, and, as owner, possesses an unquestionable right to impose a charge for its use. The Federal Government is now selling coal lands on the public domain at prices which, on the average, approximate one-tenth of one cent per ton of the coal which it is estimated the property can commercially yield. If the coal be used to produce power under average conditions this tax is substantially equivalent to 0.5 cents per 1,000 kilowatt-hours as against an average rental of 20.86 cents per 1,000 kilowatt-hours now imposed in the case of water power. The theory of conservation unquestionably points to an increase in the price fixed for coal lands or a decrease in waterpower rental, or both. The general features of the present contract agreement enforced by the Forest Service as regards fifty-year limit of the period of appropriation should be preserved. The other restrictions now imposed should also be retained except that certain clauses should be modified to meet the practical objections which have been pointed out.

(2) The charge imposed upon water powers should be based upon the amount of water appropriated and the effective head resulting from the topography of the government lands concerned. Under the present plan, it is necessary to measure the water in order to fix the third deduction from the charge based upon output. The difficulty of measuring water, therefore, must be met and it is easy to fix the second-feet appropriated as to fix the deduction allowed for artificial storage by a permittee.

(3) The third suggestion is that the government engineers of the department or bureaus concerned develop comprehensive preliminary plans for the development of water powers of a given watershed and that these water powers collectively or severally be leased to the highest bidder, the government, of course, reserving the right to reject all bids.

The president's address was received with great applause and on motion of Dr. Chas. P. Steinmetz, seconded by Mr. Lee, it was decided to request the Board of Directors to bring the address to the notice of the proper government officials.

Consideration of the standardization rules was postponed to a subsequent session. The meeting was then turned over to William L. Robb, chairman of the electric lighting committee. The paper by Edward B. Rosa and G. W. Middlekauff on "Carbon-Filament Lamps as Photometric Standards," was then presented. In the absence of Doctor Rosa it was read by Chairman Robb.

CARBON-FILAMENT LAMPS AS PHOTOMETRIC STANDARDS.

This paper recounts the experiments made at the Bureau of Standards in Washington to determine the permanency of carbon-filament lamps as standards of light. The flame standards are not reliable for precision work in photometry, nor are they as convenient as primary standards ought to be. Carbon-filament lamps have been found to be the most successful photometric standards which have yet been applied. For many years they have been used as convenient secondary working standards and in recent years they have been employed in making careful comparisons of the photometric standards of the United States, England, Germany and France. The experiments undertaken at the Bureau of Standards were with the object of finding the performance of the lamps during the seasoning process, and also during subsequent burning which would correspond to a long useful life of the lamps as standards. A double photometer equipped with potentiometers for the precise measurement of current and voltage was used in these tests. Automatic recording cylinders were used to take down the readings. The tests included determinations at constant voltage, constant current and constant watts, and from these it was found that the most reliable results were obtained when the lamp was run at constant watts. Most of the tests were made with a batch of 200 sixty-four-watt, sixteen-candlepower, 110-volt lamps that were mounted in thirty-two-candlepower bulbs to reduce any possible effect of blackening. Careful record was kept of these lamps through the various stages of the seasoning process. The lamps gave very satisfactory results, and it was found that with a precision photometer and expert observers a mean error in the average candlepower of six lamps measured at one time was about 0.1 per cent. In the case of four lamps burning 250 hours, the variation in candlepower was only a few hundredths of one candlepower. The authors therefore conclude that with such a precision of measurement and such a satisfactory performance the unit of candlepower not only of a commercial laboratory but also of national standardizing laboratories may be maintained for a long period of years by carbon-filament incandescent lamps much more constant than could possibly be done with any other form of primary standard as yet proposed.

Last evening the entertainment features were formally inaugurated by a brilliant reception followed by dancing.

The report of the proceedings of the remaining days of the convention will be given in next week's issue.

M. G. L.

To Centralize Factories.

A syndicate is being organized, backed by the Toledo Chamber of Commerce, to erect an immense industrial building, where small manufacturing industries can be located, and furnished with the best facilities, including electric power for manufacturing purposes. The building will be eight stories high, 100 feet wide and 300 feet long. The construction will be of reinforced concrete and will cost about $300,000. There will be a total of 240,000 feet of floor space.

Pacific Utilities Merger.

The Pacific Power and Light Company has been incorporated under the laws of the State of Maine with a capitalization of $7,500,000 divided into $1,500,000 seven per cent cumulative preferred and $6,000,000 common. The new company has taken over the following public utilities:

The gas properties in Walla Walla and North Yakima, in Washington and Lewiston, Idaho, and Astoria and Pendleton, Oregon; also the electric properties in Walla Walla, Astoria, Pendleton and Athena; also the local trolley systems in Astoria and in Walla Walla and an interurban line running from Walla Walla to Milton; the Strahorn properties consisting of electric light, power and water systems in North Yakima and along the valleys of the Columbia and Yakima rivers.

The Pacific Power and Light Company is controlled through ownership of its common stock by the American Power and Light Company, which in turn is controlled by interests associated with the Electric Bond and Share Company.

Other subsidiary companies controlled by American Power and Light Company through ownership of their entire common stocks are the Kansas Gas and Electric Company, Wichita and Pittsburg, Kan.; Portland Gas and Coke Company, Portland, Oregon. With the acquisition of the Pacific Power and Light Company its gross earnings will approximate $2,300,000.

Wireless in German Fisheries.

Consul-General Robert P. Skinner, writing from Hamburg, describes the use of wireless telegraphy among German fishing vessels:

Three Cuxhaven steam trawlers are now equipped with apparatus, and the service is so satisfactory that efforts are being made to increase it. The most marked advantages resulting from the use of the wireless telegraph in this business are the ability of captains to advise with each other at sea as to their respective catches, and the transmission of similar reports to Cuxhaven a number of hours before the return of the ships to port. Thus vessels of the same fleet which have found poor fishing are sometimes able to join other vessels more fortunately located, in time to return with good catches. All the vessels are then able to inform the managers of the public markets respecting the quantities of fish to be placed on sale, in such manner that in the event of unusual catches arrangements can be made in advance for distributing supplies in the least possible time. The receipt and transmission of hydrographic intelligence and reporting of breakdowns in engines, or other accidents of navigation are also features of importance.

Organization of a National Electric Vehicle Association.

For the purpose of discussing the organization of a national electric vehicle association, an excellently attended meeting was held during the morning of June 8 at the office of Arthur Williams, of the New York Edison Company, New York, N. Y.

The object of the proposed association is understood to be "co-operation in an endeavor to increase public interest in the electric vehicle as an economical transportation proposition."

It has been demonstrated that the electric is a decided economy, but this fact is not generally realized or understood. The efforts of the association will tend to help the user, or prospective user, to a better understanding.

The chairman appointed a committee to be known as the Plan and Scope Committee; to formulate plans for the association.

Those present at the meeting included Thomas A. Edison, Edison Storage Battery Company; Frank L. Dyer, vice-president and general manager, Edison Storage Battery Company; N. F. Brady, first vice-president, the New York Edison Company; T. E. Murray, second vice-president, the New York Edison Company; C. S. Shepard, controller, the New York Edison Company; Arthur Williams, general inspector, the New York Edison Company; Hayden Eames, general manager, the Studebaker Company; W. P. Kennedy, G. W. Hill, J. M. Hill, the Studebaker Company; P. D. Wagoner, president, General Vehicle Company; C. L. Morgan, L. Ruprecht, General Vehicle Company; P. Dumont, Baker Vehicle Company; A. G. Brown, Baker Vehicle Company; J. Kinsey, The Lansden Company; H. Greene, Couple Gear Company; A. Taylor, Electric Storage Battery Company; C. Blizard, vice-president, F. J. Stone, Electric Storage Battery Company; W. H. Blood, Stone & Webster, Boston; John Kelly, Edison Storage Battery Company; C. D. Marsh, Edison Storage Battery Company; George Hayes, Gould Storage Battery Company; W. Dowd, Gould Storage Battery Company; J. F. Becker, United Electric Light and Power Company; W. L. Secord, Westchester Lighting Company; W. D. Jones, Westchester Lighting Company; C. G. M. Thomas, general manager, New York & Queens Electric Light and Power Company; H. C. Cushing, Jr., Central Station, and Harvey Robinson, the New York Edison Company.

Forty-Second Street (New York) Railway Sale.

Final order for sale under foreclosure of the Forty-second Street, Manhattanville and St. Nicholas Avenue Railway property has been entered by Judge Lacombe, of the United States Circuit Court, in the suit of the Union Trust Company. In accordance with a decree of the court, Edward H. Childs, special master, is to sell all the property, franchises and securities at the county court house on September 1. The company is directed by the court to pay within twenty days the sum of $1,679,933, being the amount due for principal and interest on a mortgage held by the Union Trust Company on all the property, rights, title and interest of the company. The special master is directed to file with the clerk, not later than July 15, a supplementary inventory of all the legislative and special grants and privileges to the Forty-second Street company.

It is also directed in the decree of the court that seventy-five electric convertible pay-as-you-enter cars, purchased since the mortgage was given to the Union Trust Company, must be sold with the rest of the property, but that the purchaser must pay in cash $350,365 to reimburse the receiver in the amount expended for these cars.

All bidders for the property as a whole shall be required to deposit $100,000 with the special master prior to the acceptance of any bid. The decree does not fix any upset price, but the the court reserves the right to reject or accept any bid. In accordance with the decree purchasers will be given one year in which to elect to continue to operate or to discontinue the operation of any of the trackage of the company.

Three-Cent Fares in Toledo.

Some weeks ago, at the invitation of the local street-car company, the city of Toledo, Ohio, secured the services of expert accountants and began an investigation of the books and properties of the company. This was upon the promise that the city's experts would be given full leeway with permission to examine all data which might be of value, and would be given the assistance of the company in every possible way, in order that it might be definitely determined whether it would be possible for it to carry passengers at three cents as demanded by the city. The present administration, it may be noted, was elected upon a three-cent-fare platform.

The investigation proceeded harmoniously until a few days ago when the experts requested a list of the property of the company as a basis from which to further work out the cost of carrying passengers. The request was denied by the company with the statement that it had no inventory of its property and could furnish none, and making the counter suggestion that the matter of property be left to a board of experts whose decision should be binding upon both the city and the company. The city then demanded the inventory of property furnished to the bondholders of the company a few months ago. Again the request was denied with the statement that the inventory referred to was made with a view to selling the bonds of the company and did not represent fairly the property of the company. A committee of council was then appointed to formulate a reply in behalf of the city, and it is understood that this will demand the production of the inventory to bondholders, and upon refusal it is probable that negotiations will be declared off until the demand is met by the company.

Just what the outcome will be is difficult to predict, but that there are difficulties apparently insurmountable is shown by the fact that the city is absolutely bound to stand for three-cent fares, while on the other hand the company emphatically insists that such a basis is an absolute impossibility. In the meantime each day brings that much nearer the time when the city will advertise for bids and the rights in the streets will be sold to the best responsible bidder. H.

Railroad Commission of Wisconsin News.

The Railroad Commission of Wisconsin has recently handed down its decision in the matter of the City of Manitowoc vs. The Manitowoc Electric Light Company. The complaint brought by the city alleged that the rates and charges of the company were unreasonable and excessive and that the service rendered by the company was inadequate and insufficient. A careful analysis of the operating expenses of the plant for several years past was made by the commission and it was found that the company was not earning an unreasonable return upon the investment represented. For the years covered by the analysis it was found that the balance left after meeting all legitimate operating expenses and providing for depreciation was less than six per cent for interest and profit. No composite life of the Manitowoc plant was computed, but the composite life of a number of similar properties in the state made it clear that the annual allowance for depreciation in this case should be about 4.5 per cent on the total property. The commission stated "that since in this case the earnings very largely depend upon the rates charged it would also seem that the general rate level cannot very well be unreasonably high."

The decision contains the following table, which furnishes an interesting statement of the distribution of expenses of the electric plants throughout the state.

OPERATING EXPENSES OF 38 PRIVATELY OWNED ELECTRIC PLANTS IN WISCONSIN.

	Maximum Per cent	For 38 Plants Average Per cent	Minimum Per cent	For Manitowoc Per cent
Power	92.5	60.7	27.2	63.5
Distribution	22.4	9.4	.7	6.4
Consumption	19.5	7.1	.6	12.1
Commercial	14.5	4.8	.4	4.0
General	44.2	20.3	4.2	14.0

While the facts showed that the general rate level of the company was not unreasonably high, some criticism was made of the rates for the several branches of service. The commission showed that the burden of cost was not distributed fairly among the several classes of consumers. The commission stated that "as a general proposition the claim of the petitioner (city) that a sliding scale such as that in force by respondent is unjust and inequitable is borne out by the facts. A rate schedule which recognizes only the quantity of current consumed and neglects the factors of active connected load and hours of daily use of the connected load must necessarily fail to equitably distribute the cost."

Third Avenue (New York City) Railway.

Commissioner Maltbie on June 22 last read the formal decision of the Public Service Commission on the petition of the new Third Avenue Railway Company, New York City, to intervene in the proceedings for the reorganization of the Third Avenue system.

The petition is granted and it is declared that all the evidence that has been taken shall have the same force and effect as it would regarding the original petitioners, the Bondholders' Committee.

John Flint, a public accountant, was examined and explained two items not named in the company's assets. These were the Tarrytown, White Plains and Mamaroneck recently sold under foreclosure and bought in by the Bondholders' Committee, and a claim now being prosecuted in the Federal courts by Receiver Whitridge against receivers of the New York City and Metropolitan companies. Mr. Flint described this claim as being in round numbers about $10,000,000.

George W. Davison, counsel for the Bondholders' Committee, said that it was hard to say just how much the claim was for. He thought it might reach $30,000,000 for breach of term of lease of Third Avenue and failure to keep certain covenants. The commissioner asked: "Will that claim pass to the new company?"

"It will," said Mr. Davison.

The petition was submitted on June 4.

The hearing was adjourned until next Tuesday. Present indications are that the proceedings will be concluded within a short time. They have now consumed six months.

Telegraph and Telephone Operations in Belgium.

Consult H. Abert Johnson, of Liege, reports that the number of telegrams sent in Belgium in 1908 was 3,576,539, the receipts from which were $397,117; also 3,325,856 international telegrams, the receipts from which were $512,587. The telephone service gave a revenue of $1,847,590 from 34,027 telephone subscribers and 199 public telephone stations.

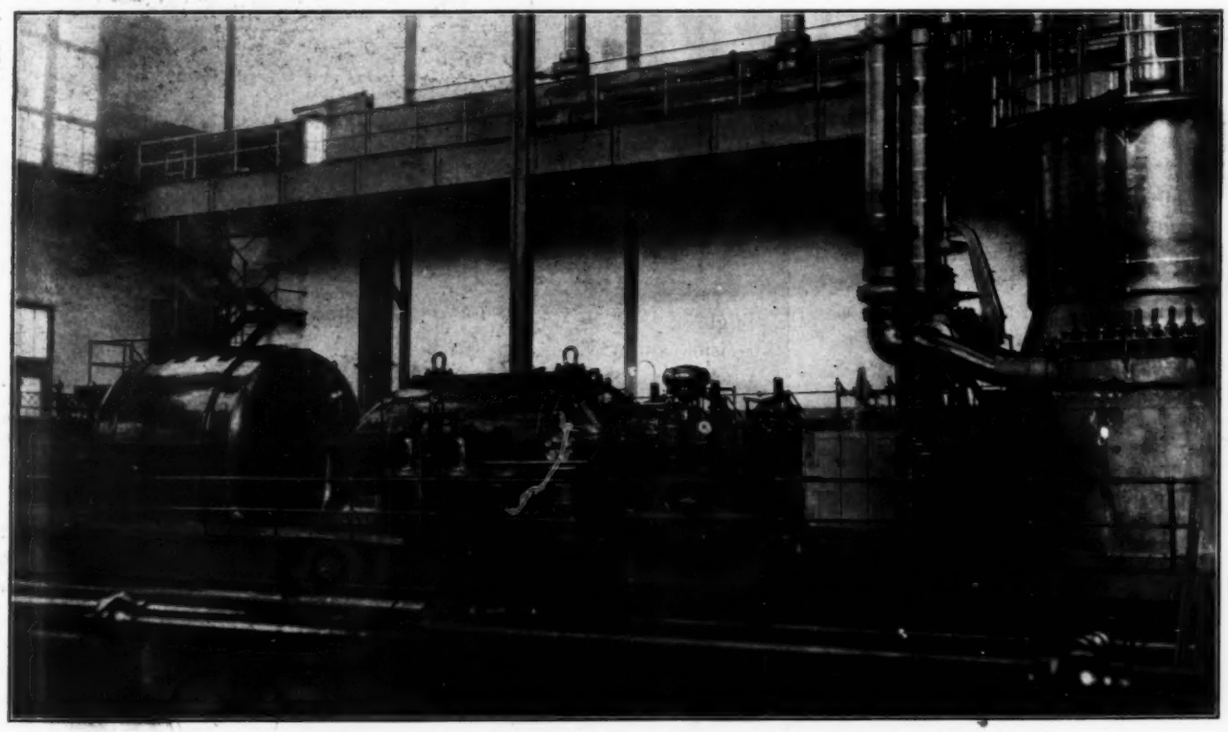
CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

AN AMERICAN 10,000-KILOWATT TURBO-GENERATOR SET.

A DESCRIPTION OF A RECENT ADDITION TO A KANSAS CITY POWER STATION.

The Missouri River power house of the Metropolitan Street Railway Company at Kansas City has recently had added to its equipment at 10,000-kilowatt turbo-generator set which possesses some interesting features. The following particulars are abstracted from an account by Edward H. Lane, which appeared in a recent issue of *Power and the Engineer;* the photographs from which our illustrtaions are taken were kindly loaned by the Westinghouse Machine Company.



THE 10,000-KILOWATT TURBO-GENERATOR SET AT KANSAS CITY, MO.

The turbine, which was built by the Westinghouse Machine Company, is of the horizontal, double-flow, combined impulse and reaction type, having for its first stage an impulse wheel with two rows of blades on it with one row of stationary blades between them. The steam, after leaving the inlet valves, is expanded in a set of nozzles from an initial pressure of 170 pounds to about sixty pounds; that is, at normal load when the inlet pressure at the primary valve is about equal to the boiler pressure. From these nozzles, the steam acts on the impulse wheel. Beyond this wheel the blading is arranged according to the standard Parsons design. After leaving the impulse wheel, the steam goes through a few rows of blades and then divides, half of it going through the hollow shaft to one low-pressure element and the other half going to the other low-pressure element. From these it is discharged to the condensers.

The machine has only one dummy piston. It is located just beside the impulse wheel and acts as a packing between the impulse-wheel pressure and the low pressure; in fact, one has to draw on his imagination a little in order to call it a dummy piston at all. The machine is practically without end thrust; what little amount there may be is taken care of by a thrust bearing of the usual type.

Oil for the machine is furnished by a rotary oil pump, set below the No. 1 bearing. The pump runner is on one end of a vertical shaft; the cam which gives the oscillations to the valve gear is on the other end. This shaft is driven by the gearing which drives the governor. The pump makes 165 revolutions per minute; the governor, 250, and the turbine spindle, 1,500.

The inlet valves are hydraulically operated instead of by steam. The pressure for the operating piston is supplied by the rotary oil pump. The

oil goes to the hydraulic cylinder at forty-five pounds pressure. The action of the cylinder is controlled by the pilot valve, which is actuated by the governor and makes 164 oscillations per minute.

The steam is supplied to the turbine through a twelve-inch pipe. It enters through the automatic throttle, and thence it passes through the strainer and the primary valve to the primary nozzles.

In case the load is too great for the primary nozzles to handle, part of the steam goes through the secondary valve to another set of nozzles on the impulse wheel.

In case of overspeed the automatic throttle is tripped by a trigger located at the end of the turbine spindle. There is also an oil relay located on the side of the hydraulic cylinder which is released at the same time and closes the inlet valves.

The foundation for the turbine and generator is a steel structure, under which are located the condensers, the wet-vacuum and dry-vacuum pumps, the gland-water pumps and the auxiliary oil pump which is used in starting and stopping the turbine.

The condensers are of the surface, Wheeler, admiralty type. The water enters at the bottom and after passing through three nests of 1.25-inch tubes, leaves at the top, through a twenty-inch discharge pipe, and enters the bottom of a thirty-inch discharge sewer. This bottom connection allows the discharge pipe to utilize about a ten-foot siphon effect, thus relieving the circulating pumps of that much work.

There are two condensers, each having 11,000 square feet of cooling surface. Each condenser has two forty-two inch hydraulically-operated gate-valves in the steam inlet. This arrangement, as well as the 1.25-inch tubes, is necessary on account of the trashy condition of the cooling water which is taken from the Missouri River. One condenser can be cut out and cleaned without making it necessary to take the turbine out of service. The turbine has an exhaust outlet at each end. These outlets are connected to each condenser by means of inverted-Y fittings. An equalizing T connects the two outlets.

The circulating water for the condensers is furnished by a central pumping station situated at the river, driven by induction motors, and discharging into a common forty-eight-inch line which supplies all of the condensers. The condensate is taken care of by two vertical, two-stage, centrifugal pumps, either of which is capable of handling the condensate, due to a 10,000-kilowatt load. The suction pipes are six inches in diameter and the discharge pipe four inches. These pumps are each driven by a direct-connected induction motor. Each motor is of fifteen-horsepower capacity and operates on 440-volt, twenty-five-cycle, three-phase current. The dry-vacuum pump is a two-stage machine, driven by a horizontal Corliss engine. The steam cylinder is eight inches in diameter; the stroke is twenty-four inches. The air cylinders are each twenty-four inches in diameter. The pump was made by the Alberger Condenser Company. It maintains a vacuum of 28.5 inches referred to a thirty-inch barometer. The generator is of 10,000 kilowatts capacity. The current is three-phase, twenty-five cycle and of 6,600 volts pressure. The generator was built by the Westinghouse Electric and Manufacturing Company.

The space occupied by the entire unit, including all of the auxilaries except the flywheel end of the dry-vacuum pump, is nineteen feet wide and forty-one feet long, or only 779 square, feet which is a low figure for this type of turbine.

ANOTHER VIEW OF THE TURBO-GENERATOR SET.

Exports of copper for the week ended June 9 were 3,356 tons. Since June 1 they were 3,843 tons.

Census Report of Municipal Electric Light and Power Stations.

Municipal central electric light and power plants, or stations, increased more than 100 per cent more rapidly in their number than the commercial stations in the United States, according to the Census Bureau's forthcoming report on the census for 1907 of central electric light and power stations.

A comparison of the number of reports received by the bureau from municipal stations in 1907 with those received from the same source in 1902 shows an increase of 53.6 per cent as against 23.4 per cent for the commercial companies.

The proportionately greater increase in municipal stations, the report states, is largely due to the fact they are practically exempt from the consolidations that so frequently occur among the commercial companies.

A further analysis of the reports show that although thirty-three municipal stations which reported in 1902 had become commercial stations in 1907, there were 113 stations reported as commercial in 1902 which had become municipal in 1907.

Comparing the details for municipal stations in 1907 with similar items in 1902, it appears that the cost of construction and equipment in 1907 was reported as $42,879,447, while in 1902 it was $22,020,473; an increase of 94.7 per cent. The gross income of the municipal stations in 1907 was $14,011,999, as compared with $6,965,105 in 1902; an increase of 101.2 per cent.

Both sums include the estimated income for current consumed in municipal buildings and in lighting streets, parks, etc. The gross income in 1907 includes $13,614,434 for electric service, as compared with $6,836,856 in 1902; an increase of 99.1 per cent. Of the amount received for electric service in 1907, there is charged to lighting $13,040,263, while in 1902 the amount was $6,748,863; a gain of 93.2 per cent. The revenue from stationary motors, as a part of the electric service in 1907, was $516,373, and in 1902 it was $70,540; an increase of 632 per cent. All other income from electric service in 1907 amounted to $57,798, as compared with $17,453 in 1902; the per cent of increase being 231.2. All other general sources of income in 1907 yielded $397,565, and in 1902 the amount was $128,249; an increase of 210 per cent.

The total number, 1,252, of municipal plants in 1907 was distributed, 150 in the North Atlantic states; 158 in the South Atlantic; 727, North Central; 166, South Central, and 51, Western.

Most of the municipal stations are in places of small population, nearly seven-eighths of the total number being located in places of less than 5,000 population and less than three per cent in places having a population of 25,000 and over. In the three divisions—the South Atlantic, the South Central, and the Western—together only one station was reported in 1907 for cities of over 100,000 population, but it is to be remembered that in these three divisions together there were only eight cities of this class according to the census of 1900. In the North Atlantic division there were sixteen cities of this class, with only two municipal plants in 1907, and in the North Central, fourteen cities, with nine municipal plants. The one station reported for the South Atlantic division was in Baltimore, while the four stations in the "500,000 and over population" class of cities in 1907 and 1902 in the North Central division were all located in Chicago.

Denver Company's Bond Issue.

Of the $25,000,000 bond issue authorized recently by the Denver Gas and Electric Company, but $730,000 has been utilized. This amount was sold for the purpose of acquiring the plant of the Denver Steam Heating Company and adjoining property on which an extension will be built.

The Utilization of Sweden's Waterpowers.

The Swedish Government has recently submitted to the Senate a very interesting bill concerning the utilization of Sweden's waterpowers by the State. The bill states that the available waterpower has been estimated by experts to be from four to five million horsepower. Of this total a half million horsepower will be in use in the near future in the service of railways and industries. The Government owns 277 waterfalls of a total capacity of about 800,000 horsepower. It began a month ago to exploit the enormous power of the Trollhaettan, and a proposal to utilize the Porjus Falls of the Lulea River in Northern Sweden for the operation of the Finnish-Swedish Border Railway is already before the Senate. If the electrical operation of this railway in the high north proves a success, the Swedish Government hopes to operate all its railways electrically before long, by means of the mighty waterpowers at its disposal. The government objects strongly to the sale of waterfalls to private enterprises. It might in certain cases lease its waterpowers to private concerns for a term of years, which should usually not be more than forty, and never more than eighty years. This bill of the Government is exciting the greatest interest in Sweden and is a subject for general discussion. Regarding the exploitation of waterpowers by private concerns, a much more far-reaching law than the above has been passed in Norway. There the private owner may utilize his waterfall for industrial purposes only on the condition that after a certain time, generally eighty years, the entire installation becomes the property of the government. —*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), May 12.*

Lower Rates in Providence.

A reduction in the retail price of electricity from fourteen to twelve cents per kilowatt-hour was ordered at Providence, R. I., on June 14, at a meeting of the board of directors of the Narragansett Electric Lighting Company. The new rate will be applied to bills rendered after July 1, and the saving to consumers will be fourteen and one-quarter per cent.

This reduction in rates has been made possible by economies in production, resulting from the installation of steam turbo-generators aggregating 13,250 kilowatt-hour and had a system of equipment. The company has practically discontinued generating direct current and almost all its electrical energy is now generated as three-phase current.

The discounts now in force will apply also under the new rates. In 1889 the company charged twenty cents per kilowatt hour and had a system of minimum charges. Since then there have been steady reductions along with abolition of the minimum charges. Free lamp removals have also been instituted.

Divide Service Corporation in New Jersey.

With a capital stock of $15,000,000 and carrying out the idea of having a separate corporation for each of its three departments, the Public Service Corporation of New Jersey has incorporated in Newark the Public Service Electric Company. The other departments are gas and traction.

The incoporators are Thomas N. McCarter, Col. Edwin W. Hine, president and secretary, respectively, of the parent corporation, and Dudley Farrand, who is the general manager of the electrical properties as now constituted. James P. Dusenberry is the registered agent. He is also treasurer of the Public Service Corporation. The total paid up capital is $10,000.

With the exception of directors' shares, a necessary provision, all of the stock will be held by the Public Service Corporation.

Philadelphia Company Insures.

The Philadelphia Rapid Transit Company, after carrying its own insurance for the past ten years, has decided to sell the securities in its insurance fund, amounting to $1,750,000, and place fire insurance with regular line companies to the amount of $18,000,000, under a schedule which is now in course of preparation. The insurance was divided between several large brokerage houses, Platt, Yungman & Company, Creth & Sullivan, Billington, Hutchinson & Company, Samuel Story & Son and Henry W. Brown & Company receiving nearly all of it. An average rate of about forty cents has been fixed by the Philadelphia Fire Underwriters' Association.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

A NEW ERA IN DOMESTIC ILLUMINATION.

BY W. T. RYAN.

You and I wonder at our forefathers' inefficient use of artificial light. We are surprised when we look back nearly 6,000 years and see that 5,910 of these years produced nothing much better than a tallow candle, with an actual efficiency of less than one per cent, i. e., less than one per cent of the radiant energy from the candle is light.

The radiation from any hot body may be resolved into parts each of which consist of ether waves of a definite wave length. All these waves have one common property, namely, they generate heat in a body which absorbs them. Radiations of which the wave lengths lie between thirty-nine and seventy-five millionths of a centimeter affect the optic nerves and give rise to light. These limits are not sharply defined, varying considerably with different persons, and with the degree of fatigue of the optic nerves. The ordinary carbon incandescent lamp has, on the above basis, an efficiency of about three per cent and the tungsten lamp about eight per cent. The average steam engine used in power plants today does not convert more than ten or twelve per cent of the heat of combustion into work. There are also several losses in the various transformations of energy between the engine and the lamp. This means, that of the coal used in electric-light stations at present, less than one-third of one per cent of the heat in the coal is actually converted into light.

If the light-giving element of a lamp were to conform to the laws of radiation of an ideal black body, the efficiency of the lamp would be a definite function of the temperature, and would increase with the temperature, reaching a maximum of over ninety degrees at a temperature of about 4,600 degrees centigrade. This temperature is far greater than any known solid or liquid body will stand.

The temperature of a carbon incandescent lamp is normally about 1,500 degrees centigrade. The temperature of the tungsten lamp is close to 3,000 degrees centigrade. Obviously, there is still room for improvement. I sometimes wonder whether the next generation will wonder that we were content with our much-exploited tungsten lamp.

However, the tungsten lamp has marked the beginning of a new era in electric lighting, especially in the home. Certain arc lamps have as high, or higher, efficiency as the tungsten lamp, but are only suitable as a source of very powerful light and are generally so unsteady as to be trying to the eye. The comparatively small areas to be lighted in residences, the small need for extremely intense light, and the very discontinuous character of the need for any light at all, makes of domestic lighting a very hard problem. Until the advent of the tungsten lamp electric domestic illumination was accomplished by means of the carbon lamp. Electric light with carbon lamps and with the usual prices for electrical energy is a luxury. A sixteen-candlepower carbon lamp uses about fifty watts. Figuring electrical energy at ten cents per 1,000 watt-hours, the cost of illumination per candlepower-hour is 0.0312 cent. A twenty-candlepower tungsten lamp uses twenty-five watts. The cost per candlepower-hour would be 0.0125 cent. An open gas jet uses five cubic feet of gas per hour, and gives approximately twenty candlepower. Gas costs on the average about $1 per 1,000 cubic feet. The cost per candlepower-hour would be 0.025 cent. A good Welsbach burner operates on three cubic feet of gas per hour, and gives on the average about fifty candlepower. The cost per candlepower-hour would be 0.006 cent. Roughly, this is one-fifth the cost of illumination with carbon incandescent lamp, and one-half the cost with tungsten lamps. The amount of illumination with a Welsbach burner is very uncertain, especially with cheap mantles. It often falls far below fifty candlepower before the mantle is finally replaced. The Welsbach burners used in the home are almost invariably the same size. In fully one-half of the outlets in every home, a twenty-five-watt tungsten lamp gives all the light that is needed. Twenty-five watts per hour at ten cents per 1,000 watt-hours costs only eighty per cent of what three cubic feet of gas at $1 per cubic foot costs. Again, on account of the ease with which electric lights are turned on and off, they will not burn as many hours as gas lights. Electric lighting with tungsten lamps costs but slightly more at the present time than lighting with gas. The lamp manufacturers hope to put on the market in the near future a tungsten lamp whose efficiency will be one-half watt per candlepower. At the present time electric light is no longer a luxury. In our large cities practically every new home is being wired for electric lights. If a one-half watt per candlepower lamp becomes a success commercially, electric light will be considered a necessity in almost every home.

At least thirty distinct advantages may be claimed in favor of electricity for lighting, such as convenience, adaptability, absence of vititation of the atmosphere, depreciation of property, such as decorations, elimination of matches, etc. A vigorous missionary propaganda advertising these features will accomplish much in a short time.

The Minneapolis General Electric Company reports that in Minneapolis, Minn., at present, and for some months past, the residence lighting business is increasing each month at the rate of about 100 per cent over the increase in corresponding months last year, and that the point of saturation is yet a long way off.

Residence lighting is not a losing proposition because of the scattered areas which must be served. It is not, as is often thought, a necessary evil which must be endured. It has a very large advertising value, and in addition in most cases may be made to yield a profitable direct income. In smaller towns it is obviously the main source of income. In large cities the cost of the distributing system is very often no greater than it is in the downtown district, as overhead construction prevails in the residence district and underground construction is required in the business district. Moreover, the increasing use of the electric flatirons, fans and cooking utensils is extending the load over longer hours.

An electric flatiron consumes about 450 watts. At ten cents per kilowatt-hour the cost would be 4.5 cents per hour. A woman will do more ironing in two hours with an electric iron than in three hours in the old way, on account of not having to keep changing the irons. Then, again, it is much cooler work, since only the iron and not a stove in addition must be kept going. More than ninety-five per cent of the electric irons which are left on trial are sold. A nice little bedroom fan can be obtained which will operate on twenty watts. The cost at ten cents per kilowatt-hour is only one-fifth of a cent per hour. With a coffee percolator and a toaster, a sufficient amount of coffee and toast for a family of six may be prepared at a cost of not more than two cents. A one-eighth horsepower motor, consuming approximately 125 watts, will do the family washing at a cost of only one and one-fourth cents an hour for the time the machine is actually running. The result is that the clothes are always washed better, and in many cases the careless washwoman is dispensed with. All of the above utensils not only popularize the use of electricity and contribute to the comfort of the home, but they give to the central station considerable very valuable off-peak load.

The conservation of our natural resources is now being given very much attention. According to the United States Census Bureau about $20,000,000 is expended each year for coal used in furnishing electric light. With a very liberal replacement of carbon lamps by tungsten lamps, the rate at which fuel is being consumed for incandescent lighting could be reduced at least one-half, thus saving to the United States about $10,000,000 worth of coal per year. Gifford Pinchot, the former chief forester of the United States, predicts that if the present rate of excavation is allowed to continue, the whole visible supply of anthracite coal in the United States will be gone in fifty years, and all the bituminous in a little more than one hundred years. It has been said that the great Pittsburg coal seam to which the city of Pittsburg owes its industrial position will be exhausted in one hundred years at the present rate of depletion.

A campaign for the use of high-efficiency lamps by all central-station men and all those who have influence, either directly or indirectly, with electric-light companies would therefore result in the conservation of quite a portion of our coal supply.

Illuminating Engineering Society; Meeting of Chicago Section.

The final meeting for the season of the Chicago Section of the Illuminating Engineering Society was held on the evening of June 23 at the new refectory near Center Street in Lincoln Park, Chicago. The particular object in calling the meeting there was to enable the members to make a critical study of the lighting arrangements in the main dining room on the second floor of the building. During the progress of an excellent dinner the lights were turned on and the members given an opportunity to form their impressions of the lighting effect.

Before taking up the main topic of the evening, Geo. C. Keech, chairman of the nominating committee, reported the following list of nominees for officers of the section for the ensuing year: F. J. Pearson, chairman; W. E. Keily, secretary; J. G. Learned and C. A. Luther, managers. These were unanimously elected by a joint ballot.

Chairman A. Scheible then called on J. L. Hamilton, the architect of the building, to open the discussion by explaining his ideas in the design of the lighting fixtures.

Mr. Hamilton modestly stated that the chief consideration throughout the design of the building was to make it a restful and comfortable place to dine or lunch. With this idea in mind he conceived that the lighting of the main dining room (which is about eighty-four by forty-eight feet in ground area and has a steel-trussed slanting ceiling with a height of thirty-three feet at the center of the skylight and of twenty-one feet at the wall line) would be best carried out by suspending a chandelier in the form of an art glass globe at the junction of the roof trusses near each end of the room. These two pendent globes each contain eight Nernst lamps, four in the lower and four in the upper hemisphere. These are entirely screened from view by the glass surfaces of the globe, which are quite uniformly illuminated and harmonize well with the colors of the buff brick and ornamental Rockwood tile of the walls and the green trusses and natural wood finish of the ceiling. Around the external middle band of the globe project horizontally eight small incandescent lamps in frosted meridian bulbs. Supplementing the lighting from these two central pendants are twenty wall brackets about six feet from the floor; each has three arms finished in verde antique and carrying a twenty-five-watt tungsten lamp in a frosted globe. Thus the wall brackets take 1,500 watts and each of the two pendent globes is supplied with 1,200 watts or a total of 3,900 watts for the lighting of the room. Mr. Hamilton called attention to the brackets on the concrete columns of the pergolas connecting the two wings of the building to its central portion and also to the concrete standards surmounted by Jandus arc lamps in front of the building and on the boat landing along its other side. These were described in these pages in the issue of December 25, 1909.

At the conclusion of Mr. Hamilton's remarks a very general and informal discussion ensued. The two central lighting fixtures were generally admired for their evenly brilliant appearance and their artistic harmony with the remainder of the room.

The wall brackets, however, were criticized, first because they were too low and in the range of vision, and second, because they were almost too plain. It was suggested that they might well have been placed near the tops of the columns along the wall, so as to be more out of the line of sight, distribute their light better throughout the room and also to illumine the mural decorations to better effect. If the brackets had been placed higher

up, it was also suggested that they might have been vastly improved by being made up as art glass box lights to harmonize in color and general design with the two pendants.

There was also criticism of some very plain tungsten clusters that were exposed on the balcony of the room and in the wings of the building; these certainly did not harmonize with anything in the room and looked as if they had been added as an afterthought.

The illumination in the main dining room when the side lights were turned off was found to be inadequate. With them lighted it was much improved, but there was noticeable lack of uniformity of distribution, there being quite brilliant lighting along the walls and insufficient lighting in the middle of the room, which probably would have been rendered satisfactory by raising the side lights to the tops of the columns.

Finally it was noted that the lighting of that room marked a distinct advance in showing how an architect may handle a difficult problem in illumination and do it artistically, but there was left still further opportunity for harmonizing the artistic and scientific requirements.

Commission News From New York.

The Public Service Commission, Second District, has received an application from the Livingston-Niagara Power Company for permission to exercise franchises in the towns of Avon, Caledonia, Geneseo, Lima, Livonia and York, and the villages of Avon, Caledonia, Geneseo, Lima, and Livonia in the county of Livingston, and the towns of Mendon, Rush and Wheatland, and the village of Honeoye Falls in the county of Monroe. Franchises have been granted in all of the localities mentioned excepting the town of Livonia, and the villages of Avon, Geneseo, Lima and Livonia in the county of Livingston and the village of Honeoye Falls. In each of these places there is an existing electrical corporation. The company has arranged to receive electric current from the lines of the Niagara, Lockport and Ontario Power Company and proposes to distribute electricity for light, heat and power in the territory mentioned.

The Rochester, Syracuse and Eastern Railway Company has filed tariffs with the Public Service Commission, Second District, which will provide for the transportation of freight locally over this line hereafter.

The Commission has authorized the Canisteo Gas Company of Canisteo, Steuben county, to execute a first mortgage covering all its properties to the amount of $50,000 and to issue presently $12,000 par value of bonds. The bonds are to retire outstanding bonds of an equal amount.

The Commission also has authorized the Howard A. Pierce Electric Light Company to issue its capital stock to the amount of $12,500 for the purchase of the interest of Howard A. Pierce, Elizabeth Pierce and Laura S. Frank in the electric lighting plant in the village of Hamburg, Erie county.

The Commission has authorized the transfer of the works, system and franchises of the Howard A. Pierce Electric Light Company for a water power plant at Water Valley, and the transmission line from Water Valley to the village of Hamburg, Erie county, and the distribution system in the village owned and operated by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank.

The Commission has authorized Mary E. Seeley and Chales A. Seely to maintain and operate an electric lighting plant in the villages of Spencer and Candor, Tioga county.

The Commission has also authorized the Fulton County Gas and Electric Company to acquire from the Mohawk Hydro-Electric Company the franchise granted in May, 1910, by the Superintendent of Highways, the town of Ephratah, Fulton county. The Fulton county company is also permitted to construct and maintain an electric lighting plant in the town of Ephratah.

The Commission in considering the matter of the application of the Hartwick Power Company, under section 68 of the Public Service Commissions Law, for permission to construct, maintain and operate in the village of Richfield Springs, a distributing system for the furnishing of electricity for light, heat and power, has determined that the defects in the service afforded by the Richfield Springs Electric Light and Power Company may be corrected by the exercise of the powers of this Commission, and has further decided to deny the application of the Hartwick Power Company upon the condition that the Richfield Springs Electric Light and Power Company will make improvements and betterments in accordance with recommendations of the Commission with a view to improving the service, but to give the application of the Hartwick Power Company further consideration if the Richfield Springs company does not see fit to comply with the Commission's suggestions.

Fall Convention of New England Section, National Electric Light Association.

The executive committee of the New England Section of the National Electric Light Association at a meeting in Boston on June 22, decided on the arrangements for the second fall convention of the section. The convention will be held at the Griswold, Pleasant Point, New London, Conn., September 13 and 14. A special train will leave Boston at 3 p. m., Monday, Sept. 12, arriving in New London at 5:30. The guests will then be taken by boat to the hotel.

On the programme of papers will be "The Advantages of a Uniform System of Rate Making," "Building up Electric Sign Business," "Special and Decorative Street Lighting," and "The Best General Policy of Publicity." These papers will be distinctive in their treatment of the subjects in hand.

Interurban Poultry Car.

The innovation made by the Evansville & Southern Indiana Traction Company of inaugurating a poultry car to be run over the Rockport line every Saturday, bids fair to become a great success.

At the request of Evansville produce merchants the traction company ran an experimental car over the Rockport line and the results were so satisfactory as to warrant the operation of the car permanently.

The car will leave Rockport every Saturday morning at 7 a. m., and will arrive in Evansville at 11 a. m., stopping at all the intermediate points to take on eggs, chickens, etc. It is claimed that this car operated regularly will mean a great saving and convenience to both the buyers and the producers. All the farmers living in the neighborhood of the traction line can get their produce to market as regularly and quickly as do the dairy men. S.

TELEPHONY—TELEGRAPHY, and WIRELESS.

The Condenser Telephone.

The condenser telephones recently brought out by C. Karl Ort and Josef Rieger, of Koschlitz, Bohemia, are based on observations which date back to early telephone days. It was observed, says *Engineering*, of London, England, that ordinary tin-foil condensers provided with paper insulation would give out notes when the foils were charged

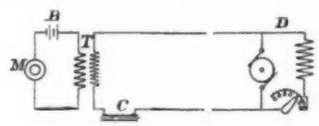


FIG. 1.

up to potentials of several hundred volts. Telephones of this type were constructed by Varley and by Dolbear, and later by Dunand and by Marshall. They all required high-tension batteries, however.

In their experiments Ort and Rieger started from the well-known combination, due to Duddell, of an arc lamp, fed by direct currents, with a condenser and a coil in a shunt. The burning of the arc produced current fluctuations in the shunt circuit which were audible. This combination was soon replaced by the arrangement illustrated in the diagram, Fig. 1, in which M is a microphone, B a battery, and C a condenser. Potentials of more than twenty-five volts were, however, needed to secure fair articulation. It was noticed, moreover, that the free edges of the sheets of tin foil oscillated in an irregular manner, interfering with distinct articulation, and the experimenters also ascribed a high hysteresis effect to the paper insulation. The sheets of tin foil were, therefore, clamped, and the insulation was effected by means of shellac.

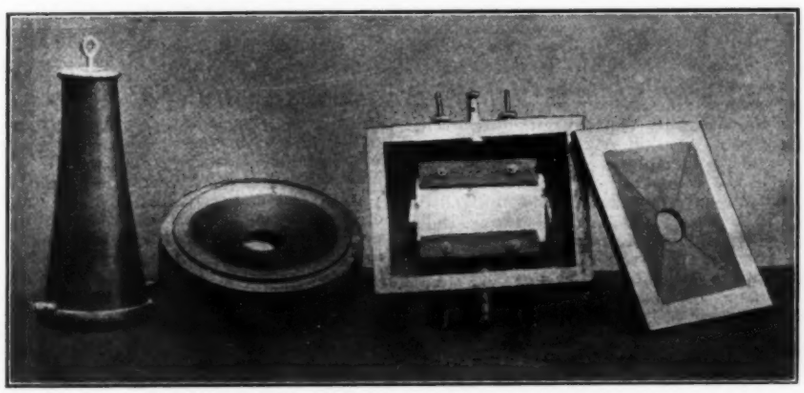


FIG. 4.—VARIOUS WAYS OF MOUNTING CONDENSERS.

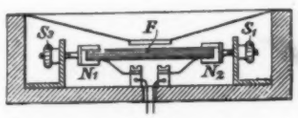


FIG. 2.

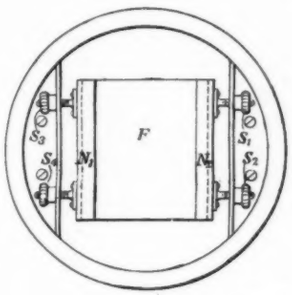


FIG. 3.

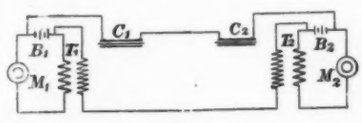


FIG. 5.

Figs. 2 and 3 illustrate the new apparatus. The layers of tin foil F are clamped at N_1 and N_2, and kept stretched by the screws S_1 and S_2. The photograph, Fig. 4, shows various ways in which the condensers are mounted. Fig. 5 explains another arrangement. The terminals of the condensers C_1 and C_2 are joined to batteries of two or three cells, which are inserted in the microphone circuits. With another arrangement, again, one battery sufficed, but loud sounds, which would be audible all over the receiver room, required more than the fifteen dry cells which were used on an experimental line of five miles length, and the experimenters returned to the dynamo as the source of current.

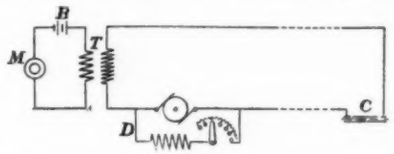


FIG. 6.

As a low current density suffices, a small dynamo will do. In Fig. 6 the secondary of the microphone transformer T damps the common current fluctuations in the dynamo circuit, which would otherwise be unpleasantly noticeable. The microphone currents, on the other hand, react on the dynamo, as in the case of the speaking arcs. A more efficient connection is indicated in Fig. 7. A special coil S_1 of several turns is wound over the shunt coil of the dynamo, and joined to the microphone M and the battery B. The condenser is connected with the dynamo terminals. Other combinations are possible.

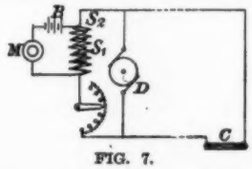


FIG. 7.

The chief point seems to be to keep the potential sufficiently low—that is, below the natural vibrations of the sheets of tin foil. As a consequence, the articulation is superior, and stronger microphones can be used, yielding higher potentials in the secondary, so that the intensity of sound is increased. For the ordinary telephonic service the dimensions of the condensers as built by Ort and Rieger are small—1.5 by 2.5 inches, the capacity ranging from 0.015 up to 0.04 microfarad. When loud speaking is desired, larger dimensions—eight by four inches—and higher capacities, up to one microfarad, are required for the condensers, and the potentials, which will range from four up to twenty volts in the first instance, may have to be raised to 120 volts. In the latter case a dynamo will be the source of current.

Earth currents, it is also claimed, have no influence upon these condenser telephones, and if the condenser is made of gold foil and rubber, the telephone may be used also in rooms exposed to dampness and acid vapors. With the aid of an ordinary plug contact the telephones may be worked from the leads of an electric lighting installation.

New Wireless Law.

A recent dispatch from Washington, D. C., states that President Taft will sign the bill to require apparatus and operators for radio communication on steamers which has been passed by both houses in substantially identical form and it is expected that the measure will go into effect within a few days. The passage of the bill is the outcome of a lengthy conflict and it is believed that the measure will not inflict hardship upon any large class of vessels, inasmuch as the majority of these falling within the terms of the act are already provided with apparatus. The measure is thus simply a safeguard to prevent negligence on the part of vessel owners who might be disposed to dispense with the protection afforded by such apparatus.

The bill, as it will undoubtedly become law, states that from and after the first day of July, 1911, it shall be unlawful, under a penalty not exceeding $5,000, for any ocean going steamer of the United States or any foreign country carrying passengers and carrying fifty or more persons, including passengers and crew, to leave or attempt to leave any port of the United States unless such steamer be equipped with an efficient apparatus for radio communication, in good working order, in charge of a person skilled in the use of such apparatus, which apparatus shall be capable of transmitting and receiving messages over a distance of at least one hundred miles night or day. Vessels plying between ports less than two hundred miles apart are exempt.

For the purpose of this act apparatus for radio communication shall not be deemed to be efficient unless the company installing it shall contract in writing to exchange, and shall, in fact, exchange as far as may be physically practicable to be determined by the master of the vessel, messages with store or ship station using other systems of radio communication.

Telephone Company to Pay for Franchise.

The Bureau of Franchises, New York, N. Y., recommended to the Board of Estimate at a recent meeting that a public hearing be granted the Independent Telephone Company as to its proposition to install the service in the city of New York. During the McClellan administration a number of independent telephone companies applied for franchises. Recently the Bureau of Franchises wrote these companies whether they desired to renew their application. The Independent Telephone Company was the only one to reply and it said in its letter of application that it would pay to the city for every instrument installed $1 and would guarantee the installation of at least 100,000 instruments. The president of the Independent Telephone Company is Louis Annis Ames.

The Telephone in Turkey.

Henry L. Jones, secretary of the American embassy at Constantinople, furnishes the following information concerning the telephone concession recently granted by the Turkish Government:

The syndicate is composed of the Western Electric Company, New York, the French Thomson-Houston Company, Paris, the directors of the National Telephone Company, London, and the British Insulated and Helsby Cables Company (Limited), London.

The concession is for the exclusive operation of telephones in Constantinople and environs, and is to run for thirty years from the date of its confirmation by an irade. The construction may be done by the syndicate, but the operation must be conducted by a Turkish company, the syndicate being the stockholders. The government is to have the right to purchase the concession and plant, after ten years, upon a valuation placed thereon by appraisers, whose mode of selection is set forth in the contract.

Although the Council of Ministers has approved the concession, it is held in abeyance until submitted to Parliament for approval.

A Telephone Stock Deal.

The American Telephone and Telegraph Company has offered to exchange its shares for stock of the Nebraska Telephone Company on the basis of three shares of American for each four shales of Nebraska.

Stock for exchange must be delivered in New York on July 15. Fractional shares will be paid for at the rate of $105 for Nebraska Telephone.

The New Telefunken System.

In a recent address before the German Electrotechnical Association, Count Arco described some new arrangements and measurements on installations of the "singing spark" system of wireless telegraphy, among them an apparatus for the objective demonstration of sounds and noises, and a device for simultaneously representing the sound acoustically and the regularity of the spark discharges optically. A station of eight kilowatts primary energy was described and the methods of ascertaining the degree of efficiency of such a station of the singing spark system explained. Two eight-kilowatt stations of this type installed on steamers plying between Hamburg and Kamerun, Africa, have repeatedly been in communication at a distance of 3700 kilometers. By means of two sound intensifiers tuned to different notes, Count Arco also showed for the first time duplex telegraphy with one receiver and two transmitters.

The first output of radium from the Trenwith mine, St. Ives, Cornwall, consists of about twenty-grains and is valued at $150,000.

Telephone and Telegraph to be Regulated.

The Railroad Bill, as reported by the Conference Committees of the Senate and House of Representatives provides for the establishment of the Commerce Court, and the appointment of the judges, clerks, etc., necessary for its maintenance; that its decisions may be reviewed by the Supreme Court of the United States, appeals to be taken within sixty days after the entry of a judgment or decree, and appeals to the Supreme Court from the Commerce Court to take precedence over all other cases except criminal cases which might be referred to that court.

All cases or proceedings in the Commerce Court are to be brought by or against the United States, the Attorney General to have charge and control of the interests of the Government, the Interstate Commerce Commission being allowed to also appear; communities, associations, corporations, firms and individuals who might be interested in any case before the Interstate Commerce Commission or in any suit which might be brought under the provisions of the bill have the right to intervene; complainants before the Interstate Commerce Commission interested in a case would have the right to appear and be made parties to the same, and to be repesented by counsel.

The Act to Regulate Commerce is amended to apply to telegraph, telephone, and cable companies (whether wire or wireless), engaged in sending messages from one state, territory or district of the United States, to any other state, territory or district of the United States or to any foreign country, who shall be considered and held to be common carriers within the meaning and purpose of the Act, but not to the transmission of messages by telephone, telegraph, or cable wholly within one state.

All charges made for any service rendered or to be rendered for the transmission of messages by telegraph, telephone, or cable, as aforesaid, or in connection therewith, shall be just and reasonable; and every unjust and unreasonable charge for such service or any part thereof is prohibited and declared to be unlawful; but messages by telegraph, telephone, or cable, subject to the provisions of this Act, may be classified into day, night, repeated, unrepeated, letter, commercial, press, government and such other classes as are just and reasonable, and different rates may be charged for the different classes of messages. Nothing in the Act is to be construed to prevent telephone, telegraph, and cable companies from entering into contracts with common carriers, for the exchange of services.

No common carrier subject to the provisions of the Act shall, after January first, 1907, directly or indirectly, issue or give any interstate free ticket, free pass, or free transportation for passengers, except to its employees and their families, and to linemen of telegraph and telephone companies; but this provision is not to be construed to prohibit the privilege of passes or franks, or the exchange thereof with each other, for the officers, agents, employees, and their families of such telegraph, telephone, and cable lines.

Whenever, after full hearing upon a complaint or after full hearing under an order for investigation and hearing made by the Commission on its own initiative, the Commission shall be of the opinion that any individual or joint rates or charges whatsoever demanded, charged or collected for the transmission of messages by telegraph or telephone as defined in the Act, are unjust or unreasonable or unjustly discriminatory, or unduly preferential or prejudicial or otherwise in violation of any of the provisions of the Act, the Commission is authorized to determine and prescribe what will be the just and reasonable individual or joint rate, to be thereafter observed in such cases as the maximum to be charged, and what individual or joint classification, regulation, or practice is just, fair, and reasonable, to be thereafter followed, and to make an order that the carrier or carriers shall cease and desist from such violation to the extent to which the Commission finds the same to exist.

The commission will, upon its own initiative have the right to investigate any proposed change in rates, and to hold hearings for the purpose of furthering its investigations, and may, by giving notice to the person filing the proposed changes, hold the matter open for the purpose of investigating, for a period not exceeding 120 days beyond the time when such changes would otherwise have become effective, the burden of proof of the reasonableness of a rate to be placed upon the person filing same.

The Commission shall not establish any route, classification, or rate between street electric passenger railways not engaged in the general business of transporting freight in addition to their passenger and express business, and railroads of a different character.

Many Notable Exhibitions in London, England.

Consul-General John L. Griffiths states that while the Japan-British Exhibition is the largest affair of its kind to be held in London this year it is only for Japanese and British displays. He gives a list of others:

Fourth International Printing, Stationery, and Allied Trades Exhibition, held May 25 to June 9.

Naval, Mercantile Marine, and General Engineering Exhibition, to be held September 1 to 26. Organizing manager, Balfour House, Finsbury pavement, E. C.

Pure Food and Allied Trades Exhibition to be held at intervals in London, Birmingham, and Glasgow. Organizing manager, 75 Chancery lane, E. C.

Eighteenth Annual International Confectioners', Bakers', and Allied Trades' Exhibition and Market. September 3 to 10. Address: Trades' Markets and Exhibitions, Limited, Palmerston House, Old Broad street, London, E. C.

Eighteenth Annual International Grocery, Provision, Oil, and Italian Warehouse and Allied Trades' Exhibition and Market. September 17 to 24. Address as before.

First International Chemical Engineering and Industries Exhibition: September 1 to 26. Address: Organizing manager, Balfour House, Finsbury pavement, E. C.

New York Electrical Society Elects Officers.

At the annual meeting of the New York Electrical Society, held on June 15 at the new Pennsylvania depot, Thirty-second Street and Seventh Avenue, the following officers were elected: President, Robert T. Lozier; vice-presidents, H. L. Doherty, A. S. McAllister, Ernst Woltmann; secretary, George H. Guy; treasurer, H. A. Sinclair. A biography of Mr. Lozier appears on another page of this issue.

Electrification of Railways.

Three Important Papers to be Read Before Joint Meeting of Institution of Electrical Engineers and American Society of Mechanical Engineers in England in July.

The British Institution of Electrical Engineers and the American Society of Mechanical Engineers will hold a joint meeting in Great Britain on July 25 to July 30. Meetings will be held at Birmingham on July 25, 26, 27 and 28, and in London on July 28, 29 and 30.

Among the very important papers which will be presented at London, on July 29, there will be several on the electrification of railways. These will include the following:

"Electrification of Railways" by George Westinghouse, president of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., and president of the American Society of Mechanical Engineers.

"Economics of Railway Electrification" by William Bancroft Potter, member of the society, and chief engineer of the railway department of the General Electric Company, Schenectady, N. Y.

"Electrification of Trunk Lines" by L. R. Pomeroy, of New York, member of the society.

The following abstracts of these important papers have been released for publication:

THE ELECTRIFICATION OF RAILWAYS.

AN IMPERATIVE NEED FOR THE SELECTION OF A SYSTEM FOR UNIVERSAL USE.

BY GEORGE WESTINGHOUSE.

In less than twenty-five years a new industrial and economic situation has been created by the development of apparatus to generate, distribute and utilize electricity. Not less than two thousand million dollars have been invested in plants to manufacture apparatus, in power houses to generate electricity, in lines of copper wire to transmit this mysterious energy, in construction of railways and their equipment, and in the manufacture of products unknown before the advent of electricity.

Large sums have already been spent in the electrification of portions of standard steam railways in England, continental Europe and America, and there is now available a fund of information of inestimable value to guide those charged with the selection of an electrical system for railway operations.

The president of our brother Institution of Mechanical Engineers, Mr. Aspinall, in his presidential address delivered April 23, 1909, placed the railway world under deep obligation for most valuable information upon the electrical equipment and operation of trains of the Lancashire & Yorkshire Railway, of which he is the worthy and skillful general manager. His observations on the effects of low center of gravity and heavy inflexible motor trucks upon the permanent way are especially valuable in that they direct attention to costs which at first were not considered with sufficient care.

Believing unreservedly that the increased capacity of a railway and its stations, the economies of operation, and other advantages will bring about gradually the systematic electrification of steam railways, my wish is that the progress of the art may not be hampered and such electrification of our main lines delayed or rendered unprofitable by mistakes which experience, judgment and foresight may enable us to avoid.

It is not my intention in this paper to direct attention to the necessity for the very early selection of a comprehensive electrical system embracing fundamental standards of construction which must be accepted by all railway companies in order to insure a continuance of that interchange of traffic which, through force of circumstances, has become practically universal, to the great advantage of transportation companies and of the public.

Having been identified with railway operations for over forty years, and with the development of the electrical industry for twenty-five years, I feel that the time is ripe for such a selection unless we are willing to regard with complacency the extension of the existing diversified systems and the creation of conditions which will prevent the general use of the most practical methods of operations.

The great difficulty in the electrification of standard railways is no longer the engineering problem of developing a locomotive and an electrical system which will operate trains, but it is a broad question of financial and general policy of far-reaching scope, considering the future electrification of railways in general as distinguished from isolated cases of limited extent, and requiring a combination of the highest engineering and commercial skill.

In 1878 there were in the United States eleven different gauges of railroad tracks in addition to the standard gauge of four feet eight and one-half inches.

The absolute necessity for uniformity of gauge of tracks both in the United States and Canada became so apparent that in due course all of the roads which had gauges wider than four feet eight and one-half inches changed to the present standard.

It may be conceded that, so far as steam railway operation is concerned, there are now no obstacles to the interchange of traffic in the broadest sense, except in the size of vehicles in certain countries where the cost of changing tunnels and bridges would be prohibitive.

REQUIREMENTS FOR INTERCHANGE OF TRAFFIC.

I feel certain you will agree that to insure interchange of traffic, the fundamental requirements, so far as operation by steam is concerned, with full regard for safety, speed and comfort, are very few in number and are covered by the following:

a A standard gauge of track.

b A standard or interchangeable type of coupling for vehicles.

c A uniform interchangeable type of brake apparatus.

d Interchangeable heating apparatus.

e A uniform system of train signals.

The additional fundamental requirements for electrically operated railways are:

f A supply of electricity of uniform quality as to voltage and periodicity.

g Conductors to convey this electricity so uniformly located with reference to the rails that, without change of any kind, an electrically fitted locomotive or car of any company can collect its supply of current when upon the lines of other companies.

h Uniform apparatus for control of electric supply whereby two or more electrically fitted locomotives or cars from different lines can be operated together from one locomotive or car.

Outside of economy in capital expenditure, and economy and convenience in operation by steam or electricity, it matters not whether each locomotive and car and the apparatus upon them differ from every other locomotive and car in size or details of construction, so long as the constructions are operative and the materials employed are used within safe limits.

DEVELOPMENT OF ALTERNATING-CURRENT APPARATUS.

Having acquired a considerable experience in the introduction upon railways of the compressed air brakes and in the development of automatic electro-pneumatic signals, I was led in 1885, because of its general analogy to operations with which I was familiar, to interest myself in the American patents of Gaulard and Gibbs (a Frenchman and an Englishman), covering a system of electrical distribution by means of alternating currents, with static transformers to reduce these currents from the high voltage necessary for economical transmission of electrical energy to the lower voltages required for the operation of incandescent lamps and other purposes.

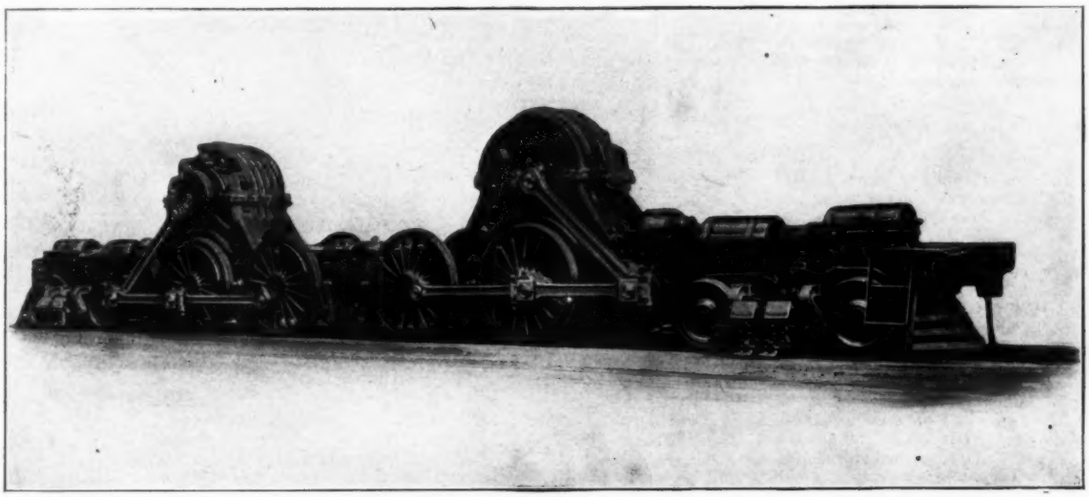
Realizing the limitations of the continuous or direct-current system, I became thoroughly convinced that the extended distribution of electricity for industrial purposes could be secured only by the generation of alternating currents of high voltage and their conversion by static transformers into currents of various voltages. Notwithstanding, therefore, the frank disbelief in its practical value by eminent scientific authorities, among them the late Lord Kelvin, I entered actively into the development of the alternating-current system of generation and distribution of electricity which is now almost universally adopted as the ideal.

In 1892 two single-phase motors of about ten horsepower were built by the Westinghouse company to determine the possibilities of using alternating current for traction work. These motors were designed for 2,000 alternations per minute and about 200 volts. They were of the series type, with commutators, and had a relatively large number of poles. These were placed upon a car and tested on a short piece of track with very short curves and rather steep grades. There was a transformer on the car on which there were several taps and the voltage was varied by means of single-pole switches. It was considered at that time that the system would be ideal for locomotive work, but as there were no such projects in view, no large motors of this type were built.

ELECTRICAL SYSTEMS FOR RAILWAYS.

As soon as these qualities of the alternating current had been demonstrated, ac-

tive minds were directed toward the development of apparatus to meet conditions constantly presenting themselves, among the most important problems being the electrification of railways. In the twenty years that have elapsed, three important electrical systems for the operation of railways have been put into practical operation, all using alternating current in whole, or in part. These systems are:



CHASSIS OF PENNSYLVANIA DOUBLE ARTICULATED LOCOMOTIVE FOR NEW YORK TUNNEL SERVICE.

a The continuous or direct-current system, usually spoken of as the "third-rail" system, which employs alternating current for transmitting power when the distance is considerable.

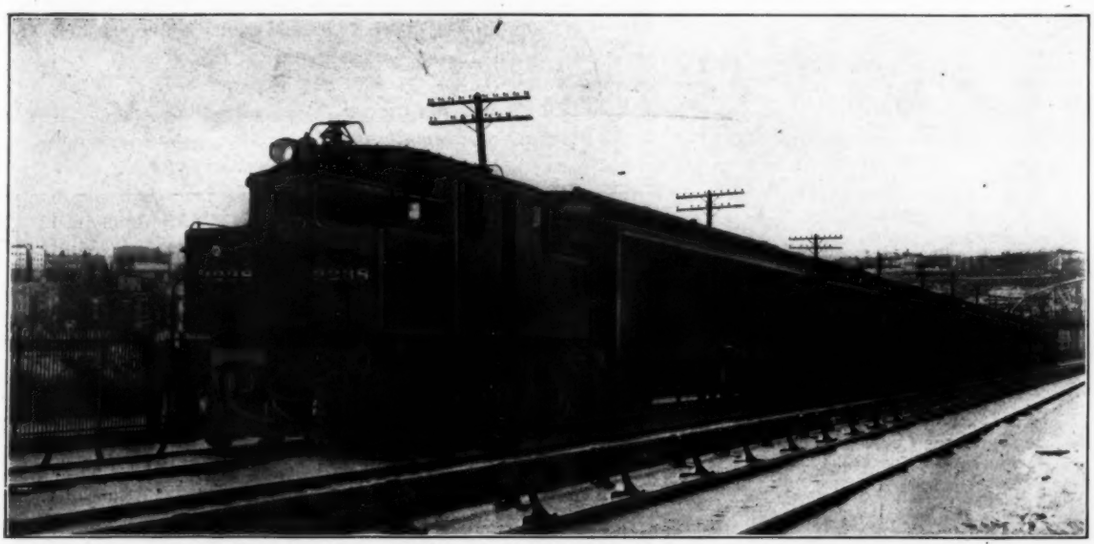
b The three-phase alternating-current system with two overhead trolley wires.

c The single-phase, alternating-current, high-tension system with a single overhead trolley wire.

In a notable case of the latter system, namely, that of the New York, New Haven & Hartford Railroad, the motors and controlling apparatus are arranged to utilize single-phase current from an overhead trolley wire at 11,000 volts, and also to be operated by current from the 650-volt third-rail system of the New York Central & Hudson River Railroad, thus making a great courage and confidence in the judgment of their experts, and rendered to all other railroads a service of the highest character, when they selected the single-phase system for the electrification of the line mentioned.

The results of the working of the three-phase system in Italy and Switzerland have been very prominently before the world for several years, and its successful use there has been a material factor in the development of confidence in electricity for the operation of railway trains. At the present time, the Italian Government is installing upon the Giovi line, which is a heavy-grade branch leading out of Genoa, a service for which thirty-five locomotives, rated at 2,000 horsepower, are now being constructed in Italy. The operation of this demonstration of the wonderful flexibility of alternating-current apparatus.

The problem before the officials of the New Haven road was not merely the electrification of a division of a few miles of track, rendered compulsory by legal requirements, but the selection of a system which would meet the needs of a great railway covering several states and having other congested centers of traffic which it might soon be desirable to electrify. In view of the fact that there had been no considerable demonstration of the single-phase system by actual use, and that the New Haven trains would be obliged to operate upon twelve miles of line already equipped with the direct-current third-rail system, it must be conceded that the directors and management of the New York, New Haven & Hartford Railroad showed much more extensive plant will afford additional valuable information as to the cost of installation and operation, and the advantages of the three-phase system.



NEW YORK CENTRAL & HUDSON RIVER LOCOMOTIVE DRAWING TWENTIETH CENTURY LIMITED TRAIN.

RAILWAY MOTORS.

Essential requisites in a railway motor are that it shall start its load and quickly accelerate it to the required speed, and that it shall operate continuously at any desired speed, or speeds. Railway conditions make desirable speeds varying from the slowest to the highest schedule speeds for regular operation, both for the movement of freight and passengers, and for making up time.

The steam locomotive, which is limited in power by its boiler capacity, is capable of continuous operation at any speed up to the maximum, but the maximum speed in

a given case depends both upon the length of the train and the grade of the track. It automatically slows down when ascending a grade, so that the actual horsepower developed does not vary greatly at different speeds. The limitation of the capacity of the electric locomotive is not the power available, as is the case with the steam locomotive, but in the capacity of the motors, and is usually fixed by the heating of their coils. An electric locomotive may safely develop for a short time an output which far exceeds its normal continuous capacity. The power and speed characteristics of electric locomotives therefore differ from those of steam locomotives.

THE DIRECT-CURRENT MOTOR.

The characteristics of the direct-current series railway motor are well known. It automatically adjusts its speed in accordance with the load, running more slowly if the weight of the train be greater, or the grade steeper. The speed with a given load, however, is definite; it is dependent upon the voltage applied to the motor and cannot readily be varied. It is true that the speed can be decreased by inserting a resistance in the motor circuit, but this is wasteful and is inadmissible except as a temporary expedient. It is true also that the motors may be connected in series, thus dividing the pressure between two motors, and thereby reducing the speed one-half; or if among four motors, to one-quarter speed. As the system of current supply involves a fixed voltage, it is obvious that for emergencies no speeds much above the maximum speed determined in the construction of the motor can be obtained.

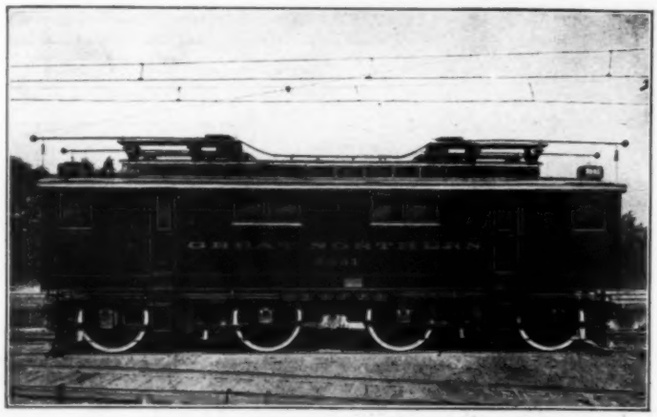
THE THREE-PHASE MOTOR.

On the three-phase system, the motor is inherently a constant-speed motor; it runs at approximately the same speed at light load and at full load; it runs at nearly the same speed up a grade as on level track, although the horsepower required on the grade may be several times that on the level. Conversely, it can run no faster on a level than it can climb a grade. In order to give a lower speed, however, the motors may be arranged upon the locomotives in pairs in a manner equivalent to the arrangement of two continuous-current motors in series, just described. Motors may also be arranged for two or more speeds, but this involves some complication in windings and connections. In all cases lower speeds can be secured by the introduction of resistances which increase the losses and lower the efficiency. In no case can the speed in any of the arrangements of motors be appreciably higher at very light load than it is at full load.

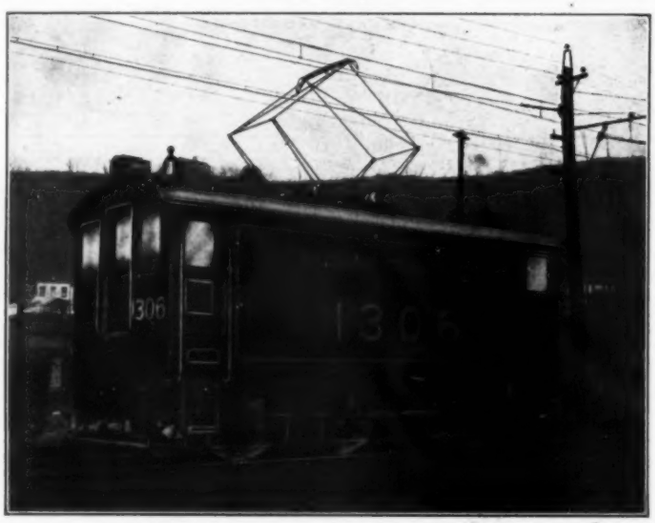
THE SINGLE-PHASE MOTOR.

The single-phase railway motor is a series motor with speed characteristics very similar to those of the direct-current motor, as the speed at a given voltage is greater or less, depending upon the load. The speed with a given load is also greater or less, depending upon the pressure applied to the motor; and this is not limited, as with direct-current motors, to that supplied by the circuit, and to one-half and one-fourth of that pressure, but is capable of adjustment to any desired degree of refinement by means of auxiliary connections from the secondary winding of the transformer on the locomotive, which is necessary for reducing the line voltage of 11,000 volts to the lower voltage required by the motors. Not only may numerous voltages less than the normal be arranged for lower speeds, but higher voltages can be provided to make possible speeds considerably above the normal. In this simple manner a wide range of efficient speed adjustment is secured which is impossible with other systems.

The question of determination of the frequency for use on single-phase railways is one of very great importance. Twenty-five cycles is in general use for power transmission purposes and has been adopted by nearly all the single-phase railroads now operating. The Midi Railway of France has adopted fifteen cycles. The lower frequency permits of a marked reduction in the size of a motor for a given output, or conversely, of a considerable increase in output from a motor of given dimensions and weight. Three-phase installations in nearly all cases employ approximately fifteen cycles. The choice of frequency is one of the most involved, difficult and important problems now to be solved.



THREE-PHASE LOCOMOTIVE USED AT THE CASCADE TUNNEL OF THE GREAT NORTHERN RAILWAY.

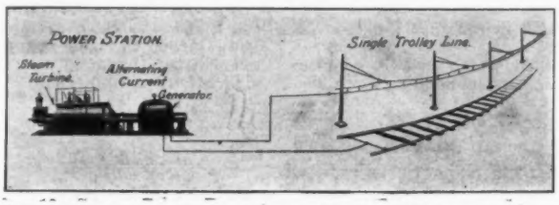


SINGLE-PHASE LOCOMOTIVE FOR PASSENGER AND FREIGHT SERVICE IN ST. CLAIR TUNNEL OF GRAND TRUNK RAILWAY.

TYPICAL SECTION SHOWING THIRD RAIL, TRANSMISSION LINE AND SIGNAL BRIDGE OF THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

SUMMARY.

Locomotives equipped with each of the three types of motors have been in successful operation and have demonstrated their usefulness, capacity and reliability in practical railway service. The three-phase motor, having a definite constant-speed characteristic, is particularly adapted to certain conditions; but, on the other hand, it has a less general adaptability to the ordinary varying conditions of railway operation. The single-phase motor has a facility of voltage control which gives an efficient means of speed adjustment, and is in this particular superior to other systems. The relative weights and costs of the several types of motors, and of the locomotives designed to accommodate them, depend upon so many conditions that comparisons must necessarily be general. It will be found, however, that these differences in locomotive cost are in many cases more than offset by the cost of the other elements in the electrical system.

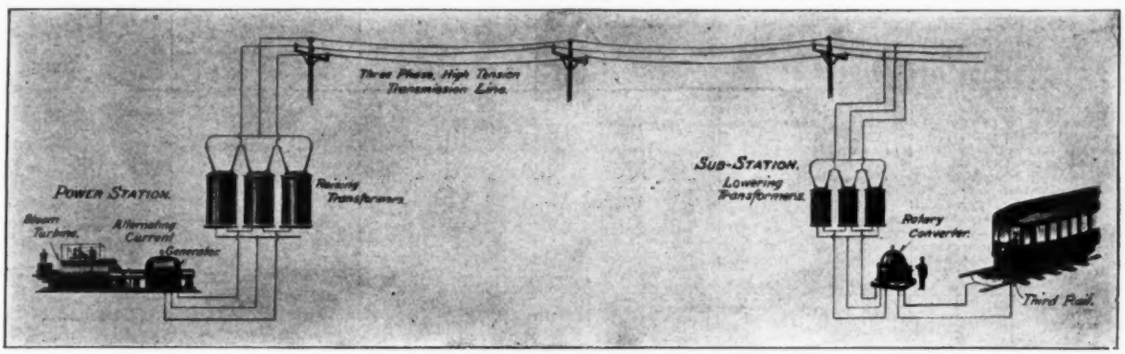


SINGLE-PHASE RAILWAY WITHOUT TRANSMISSION SYSTEM.

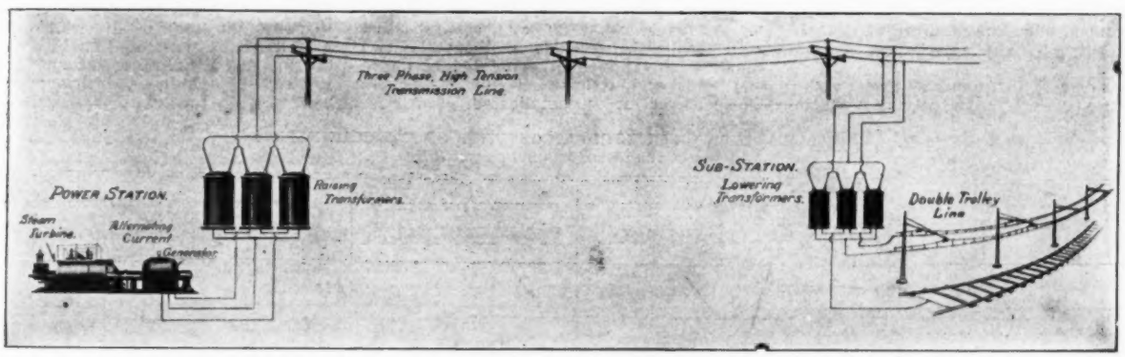
The control apparatus for all types of locomotives have been developed so that it is reliable and convenient in operation. For each system a small master controller serves to operate by auxiliary means the necessary electric switches for the control of the motors of one locomotive, or to operate simultaneously as a single unit the motors on two or more locomotives or cars in a train.

TRANSMISSION OF POWER FROM POWER HOUSE TO LOCOMOTIVE.

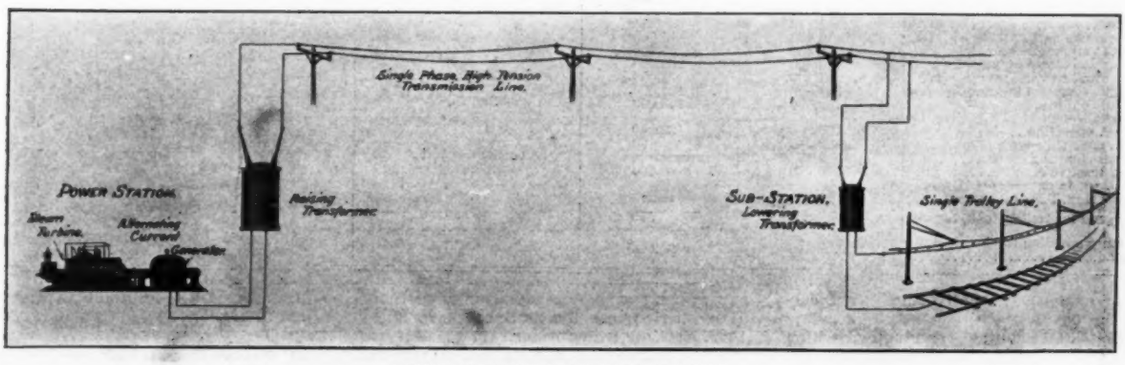
The controlling factor in the cost of electrification in nearly all cases is the system for transmitting power from the power house to the locomotive, and not the locomotive itself. The choice between the several systems must, therefore, be based upon a comparison of the complete systems. The differences between the methods of transmitting power are of far greater importance than the differences between power houses or between locomotives. The current for all systems is generated in usual practice as high-tension alternating current, for the reason that electric energy can



DIRECT-CURRENT RAILWAY SYSTEM,



THREE-PHASE RAILWAY SYSTEM,



SINGLE-PHASE RAILWAY SYSTEM.

be most economically transmitted by high-tension alternating current even though it is in some cases converted into direct current.

THE DIRECT-CURRENT SYSTEM.

For the direct-current locomotive the apparatus which intervenes between the alternating-current generator and the locomotive consists of a number of links or elements through which the electric energy must pass, one after the other. These consist of:

a Raising transformers in groups of three.

b A transmission line of three wires, substations, which require attendance, containing

c Transformers in groups of three, and

d Rotary converters for receiving the alternating current and delivering direct current.

e A third-rail contact conductor, which for heavy work must often be supplemented by copper feeders.

f The track return circuit, which must be provided with heavy bonds, and in certain cases supplemented by feeders and so-called negative boosters.

THE THREE-PHASE SYSTEM.

For the three-phase locomotives the respective links between the generator and the locomotives are:

a Raising transformers in groups of three.

b Transmission line of three wires.

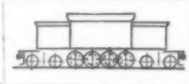
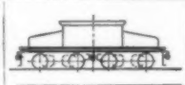
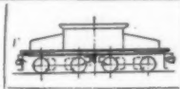
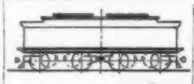
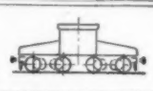
c Substation transformers in groups of three.

d Two overhead wires as the contact system.

e A track return which usually requires nothing but inexpensive bonding.

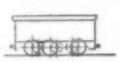
The two overhead trolley wires require a double system of overhead construction, as the wires must be kept separate and well insulated from one another; the two must be maintained at equal height above the track and at switches and cross-overs the construction is complicated.

TABLE 1 DATA ON ELECTRIC LOCOMOTIVES OF AMERICAN DESIGN
BUILT BY THE GENERAL ELECTRIC COMPANY

					
Built for	N. Y. C. & H. R. R.	Detroit River Tunnel	B. & O. R. R.	Great Northern	Paris-Orleans
Electric system	D.C.	D.C	D.C.	3-phase	D.C.
Service	Passenger	Frt. & Pass.	Frt. & Pass.	Frt. & Pass.	Passenger
First placed in service	July 1906	tests completed	March 1910	July 1909	1899
No. in service or on order May 1910	47	6	2	4	11
No. motors per locomotive	4	4	4	4	4
Armature diameter, inches	29	25	25	35¾	23½
Core length, including vent. opening, inches	19	11½	11½	16¼	12
Weight one motor, pounds	18,150	10,560	10,560	15,000	8,855
Weight all motors on locomotive	72,600	42,240	42,240	60,000	35,420
Weight all electrical parts	91,200	54,000	54,000	109,000	42,500
Weight all mechanical parts	138,800	146,000	130,000	12.,000	67,500
Weight complete locomotive	230,000	200,000	184,000	230,000	110,000
Weight on driving wheels	141,000	200,000	184,000	230,000	110,000
Weight complete locomotive for A.C. operation	D.C.	D.C.	D.C.	230,000	D.C.
Max. guar'td speed, miles per hr.	75	30	55	30	45
Feature limiting speed	track	armature	armature	armature	armature
Max. tractive effort	47,000	67,000	61,000	77,000	37,000
Loco. wt. in excess of 18% adhesion Max. T.E., A.C. operation	none	none	none	none	none
Designed for trailing load, tons. Freight		900 on 600 2% grade	850 on 500 1½% grade	500 on 2.2% grade	
Passenger					
Balance speed on level with above load	45 / 63	Freight 20.5 / Pass. 22	Freight 26 / Pass. 30	15	300 / 32

The three types of railway motors, and the three respective systems for conveying power from the generating station to the locomotives, have all successfully demonstrated their ability to operate railway trains. It is not my purpose to urge the adoption of a particular system, but rather to point out some of the well-known characteristics of these systems which have a bearing upon their limitations and their general adaptability to railway conditions, and to urge the great gain which will result from a single and universal system.

TABLE 2 DATA ON ELECTRIC LOCOMOTIVES OF AMERICAN DESIGN
BUILT BY THE WESTINGHOUSE ELECTRIC & MFG. CO.

					
Built for	New Haven	Grand Trunk St. Clair Tunnel	Pennsylvania	New Haven	New Haven
Electric system	A.C., D.C.	A.C.	D.C.	A.C., D.C.	A.C., D.C.
Service	Passenger	Frt. & Pass.	Passenger	Frt. & Pass.	Frt. & Pass.
First placed in service	July 1907	February 1908	17,000-mile test	3000-mile test	building
No. in service or on order May 1910	41	6	24	1	1
No. motors per locomotive	4	3	2	4	2
Armature diameter, inches	39½	30	53	39½	76
Core length, including vent opening, inches	18	14¾	23	13	13
Weight one motor, pounds	16,420	15,660	45,000	19,750	41,600
Weight all motors on locomotive	65,680	46,980	90,000	79,080	83,200
Weight all electrical parts	110,400	58,400	127,200	130,000	165,000
Weight all mechanical parts	94,100	73,600	204,800	130,000	165,000
Weight complete locomotive	204,500	132,000	332,000	260,000	330,000
Weight on driving wheels	162,000	132,000	207,800	130,000	133,000
Weight complete locomotive for A.C. operation	196,000	132,000	D.C.	261,000	265,000
Max. guar't'd speed, miles per hr.	about 86	30	about 80	65	65
Feature limiting speed	track	armatures	connecting rod	armatures	armatures
Max. tractive effort	19,200	43,800	69,300	46,000	46,000
Loco. wt. in excess of 18% adhesion Max. T.E., A.C. operation	88,700	none	none	13,500	17,500
Designed for trailing load, tons	250	500	553	1530 freight / 800 pass.	1500 freight / 800 pass.
Balance speed on level with above load	about 75	about 25	60	35 freight / 45 pass.	25 freight / 45 pass.

THE SINGLE-PHASE SYSTEM.

For single-phase locomotives there is:

a A raising transformer.

b A transmission line of two wires and substations widely spaced, each containing

c A lowering transformer, which supplies

d A single trolley wire.

e A track return, usually requiring nothing but inexpensive bonding.

In certain cases where the distance from the power station is not more than fifteen or twenty miles, the single-phase trolley can be supplied directly from the power house, so that only one single element, i. e., the trolley wire, intervenes between the generators and the locomotives.

REQUISITES FOR A UNIVERSAL ELECTRIC SYSTEM.

In selecting a proper electrical system for railway operation, it will probably be generally conceded that the following elements are of prime importance:

a The electric locomotives should be capable of performing the same kinds of service which the steam locomotives now perform. This will be most readily se-

cured by electric locomotives which can practically duplicate the steam locomotives in speed and power characteristics.

b The electric locomotive should be capable of exceeding the steam locomotive in its power capacity. It should be able to handle heavier trains and loads, to operate at higher speeds, and in general to exceed the ordinary limits of the steam locomotive in these regards. The readiness with which several electric locomotives can be operated as a single unit enables any amount of power to be applied to a train.

c The electric system should adapt itself to requirements beyond the ordinary limitations of the steam locomotive in small as well as large things. It should be adapted for use on branch lines, and for light passenger and freight service similar to that so profitably conducted by interurban electric roads, which in many cases run parallel to steam roads, not only taking away the traffic of the steam roads, but building up a new and highly profitable traffic, both in passenger and in express service.

d A universal electrical system requires that power should be transmitted economically over long distances and supplied to the contact conductor. The system should utilize the most highly perfected apparatus for the electric transmission of energy and its transformation into suitable pressures for use.

e The contact conductor in an ideal system should be economical to construct, both for the heaviest locomotives where the traffic is dense, and for light service on branch lines. It should impose minimum inconvenience to track maintenance; should give minimum probability of disarrangement in case of derailment, or in case of snow and sleet, and should in general be so placed and constructed as to give a maximum assurance of continuity of service.

THE FUTURE OF ELECTRIFICATION OF RAILWAYS.

The complete electrification of a railway will necessitate a rearrangement of ideas and practices in regard to operations. Coaling and watering places will not be needed; passenger trains will be differently composed, some classes being of less weight; and they will operate more frequently, thus promoting travel; other trains will be heavier than at present, or will operate at higher speeds; and branch lines, by the use of electrically fitted cars, can be given a through service not now enjoyed.

The movement of freight will undergo great changes, due to the fact that electric locomotives can be constructed with great excess capacity, enabling them to move longer trains at schedule speed on rising gradients.

The large percentage of shunting operations due entirely to the use of steam locomotives will no longer be required.

The railway companies can combine upon some co-operative plan for the generation of electricity, thereby effecting large savings in capital expenditures; and can utilize their own rights of way for the transmission of the current, not only for the operation of trains but for many other useful purposes.

Notwithstanding the fact that great strides have already been made in cheapening the cost of generating electricity by steam engines, I foresee, from the progress made in the development of gas and of engine power, a still further reduction in cost which will accelerate the work of electrifying existing railways.

One important aspect of this great question will engage the thoughtful consideration of every government, namely, the military necessity for uniform railway equipment in time of war.

There will be serious difficulties to surmount in the selection of a general system. There naturally will be arguments in favor of one or another of the systems now in use and the inclination of those who have adopted a particular system to advocate its general use. There will be enthusiastic inventors, and there will be many advocates of the common view, namely, that there is room for several systems and that each system will best meet the requirements of a particular case. There will be those who give undue weight to some feature of minor importance, such as a particular type of motor or of locomotive, instead of giving a road consideration to the whole system, and recognizing that, in the general problem of railway electrification, facility and economy in transmitting power from the power house to the locomotive, are of controlling importance.

Were there now only one system to be considered, there would be a concentration of the energy of thousands on the perfecting and simplifying of the apparatus for that system, to the advantage of railway companies and of manufacturers.

In conclusion, I can only repeat, and earnestly recommend to the serious consideration of railway engineers and those in authority, the pressing need of determining the system which admits of the largest extension of railway electrification and of a prompt selection of those standards of electrification which will render possible a complete interchange of traffic in order to save expense in the future and to avoid difficulties and delays certain to arise unless some common understanding is arrived at very shortly.

In connection with the paper by Mr. Westinghouse, there were included five appendices dealing with a description of the single-phase system of the New York, New Haven & Hartford Railroad; data on electric locomotives of American design, the summary being given in the tables included herewith; comparisons of systems of electrification, which is illustrated by a number of graphic sketches of great interest, several of which are reproduced herewith; and the early history of single-phase motors, which describes the first ten horsepower motors built by the Westinghouse company in 1892 for determining the possibilities of using alternating current for traction work. Another appendix gives some very interesting data on electrified steam roads and electric roads for trunk line service. The tables which are printed herewith give data upon many of the important railroads on which electricity is used in heavy railway service. Only such data are included as were conveniently available.

TABLE 4 SINGLE-PHASE ELECTRIFICATION
On Steam Railways and in Trunk Line Service

Road	Miles of Line	Miles of Single Track	Line Voltage	Motor Cars No.	Motor Cars h.p.	Locomotives No.	Locomotives h.p.
N. Y., N. H. & H. R.R. Main Line	23	100	11,000	4	600	41 2	1400 1000
New Canaan Br.	8	8	11,000	2	300		
Grand Trunk R.R.	3.5	13	3,300	...	...	6	900
Erie R.R. Rochester Div.	34	34	11,000	6	600	...	...
Colorado Southern Ry. Denver & Interurban	46	46	11,000	6	300	...	...
Baltimore & Annapolis Short Line	25	30	6,600	12	600	...	...
Swedish State Ry.	7	7	3,300 20,000	2	240	1	300
Midland Ry., England	8.5	17	6,600	1 2	200 300	...	...
Prussian State Rys.	16.5	31	6,600	20 42 34	330 600 345	1	1300
London, Brighton & South Coast Ry.	8.6	17.2	6,000	10	600	...	...
Rotterdam-Haag-Scheveningen	20.5	66.5	10,000	10	360	...	...
Spokane & Inland	139	139	6,600	33	600	6 5	360 720
Midi Ry. of France	75	...	12,000	30	300	2	1600

TABLE 5 CONTINUOUS-CURRENT ELECTRIFICATION
On Steam Railways and in Trunk Line Service

Road	Miles of Line	Miles of Single Track	Line Voltage	Motor Cars No.	Motor Cars h.p.	Locomotives No.	Locomotives h.p.
New York Cent. R.R.	34	132	650	137	600	67	2300
Pennsylvania R.R.	20	75	650	160	600	24	6000
West Shore R.R.	44	106	650	20	250	...	...
Long Island RR.	42	125	650	137	600	2	1200
West Jersey & Seashore R.R.	75	120	650	68	600	...	...
B. & O. R.R.	3.7	7.4	600	...	...	2 5	1600 1100
Northeastern Railway	37	...	600	...	200	2	600
Mersey Tunnel	4.8	...	600	24	600	...	...
Lancashire & Yorkshire Railway	18	60	600	...	600	...	...
Great Western Ry.	5	...	600	...	600	...	...
Metropolitan Railway	5	67	600	36	600	10	600

TABLE 6 CAR EQUIPMENT OF SUBWAY AND ELEVATED SYSTEMS IN AMERICAN CITIES
The Direct-Current Third-Rail System at Approximately 600 Volts is used in all Cases

Road	Miles of Single Track	Motor Cars No.	Motor Cars h.p.
... Elevated Railway	19	219	330
Brooklyn Rapid Transit	71	554 101	390 400
Interborough Rapid Transit (New York)	100	960 764	250 400
Hudson & Manhattan (New York)	12	140	330
Chicago & Oak Park	19.4	66	330
Metropolitan West Side (Chicago)	51.1	15 210	400 330
Northwestern Elevated (Chicago)	25.5	20 128	330 330
Southside Elevated (Chicago)	36.5	130 70	180 180
Philadelphia Rapid Transit	11	130 100	110 250

TABLE 7 THREE-PHASE ELECTRIFICATION
On Steam Railways and in Trunk Line Service

Road	Miles of Line	Miles of Single Track	Line Voltage	Motor Cars No.	Motor Cars h.p.	Locomotives No.	Locomotives h.p.
Gt. Northern R.R. Cascade Tunnel	4	6	6600	...	...	4	1000
Italian State Railways. Valtelina Railway	68	...	3000	10	400	2 7	800 1500
Giovi Railway	12.4	37.3	3000	...	...	20	2000
Mt. Cenis Tunnel	4.4	...	3000	...	...	10	2000
Isovona Cova	...	...	3000	...	...	10	2000
Swiss Federal Railways. Simplon Tunnel	12.7	14.3	3000	...	...	2 2 5	1100 1300 300
Gargal Santa Fe (Spain)	13.1	14.4	1500	...	...		

ECONOMICS OF RAILWAY ELECTRIFICATION.

BY WILLIAM BANCROFT PORTER.

National prosperity and importance are largely proportional to facilities for intercommunication, and since overland transportation is to so large an extent dependent on railways any development providing for better railway service is of paramount importance. Steam locomotives and electric motors are the two recognized means of applying power which are available for practical railway requirements. The fundamental principles which underlie the problem of train movement are the same in either instance, but a true comparison of their relative advantages can only be made by a study of each particular method.

Electrification, like any other engineering work, involves an investment against which there will be a fixed charge for interest and a liability of depreciation.

The utilization of higher trolley potentials, made possible with direct current by the development of the commutating-pole motor, and with alternating current by the development of the single-phase motor; the higher speeds of rotary apparatus in the sub-stations; and the development of the

steam turbine, have effected a material reduction in the investment required and the cost of operation.

There would undoubtedly be an advantage in having the character of the energy supplied to the contact conductor uniform, but this is out of the question on account of the great difference in the requirements of specific conditions, such as congested urban or suburban service and comparatively infrequent trunk line train movements.

The sub-station and rolling stock may be equipped for operation with direct current or alternating current, single-phase or three-phase, and what is commonly spoken of as "the system" usually refers only to that part of the general scheme of electrification which comprises the sub-station and rolling stock equipment. There are exceptional cases where the power station and transmission lines have direct relation to the rolling stock equipments; but with the development of alternating-current transmission, this is less frequently the case than it was a number of years ago when 600-volt power stations supplied power directly for the operation of 600-volt motors.

Under the conditions which exist in America, direct-current and single-phase are applicable to either level or grade work; while three-phase will probably be limited to the latter where its regenerative feature of returning energy to the line may be of value. The relative economy of the different systems of electrification is dependent on the density of traffic and the character of power available, rather than on the length of the railway.

In cases where purchased power is used, or is depended on as a reserve, the frequency of the current supplied by the power company will have a bearing on the cost of sub-stations, and will thus effect the choice of the system. For direct-current operation, rotary apparatus is used for converting the alternating into direct current, and the frequency of the supply is therefore relatively unimportant. For single-phase operation under the usual conditions, a frequency of not more than fifteen cycles is desirable; and to provide this frequency, rotary frequency-changers are as necessary as are rotary converters in the case of direct current since the frequency of existing power companies ranges from twenty-five to sixty cycles.

With power supplied at the proper frequency for single-phase operation, permitting the use of static transformers and dispensing with frequency changers, the amount of energy required for a given trunk line service is in many cases nearly the same as for direct current, the greater weight of the equipped rolling stock, and the lower efficiency of the single-phase equipments, offsetting the rotary converters and trolley-line or third-rail losses of the direct current.

CONDITIONS DETERMINING RAILWAY EQUIPMENT.

The principal conditions which determine railway equipment are:

TABLE 1. REASONABLE VALUES FOR TRUNK LINE SERVICE

Sub-Stations

	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase	11,000 v. 3-Phase
First cost per kw., complete	$35	$28	$11	$12
Comparison of installed kw., %	200-250	100-125	100	100-125
Load factor, machines in service, %	30-40	35-70	40-80	30-60
Average efficiency, %	78-88	87-92	97-98	97-98
Yearly operation and maintenance, each station	$5000	$3000	$2500	$2500

Contact Conductors[1]

	Third Rail		Overhead	
First cost, per mile	$3000 to $7000	$3500 to $7500	$3500 to $7000	$4500 to $8000
Efficiency, %	88-92	90-96	93-97	93-97
Maintenance per mile per year	$75-$125	$100-$150	$100-$200	$125-$250

Rolling Stock[1]

	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase	11,000 v. 3-Phase
Locomotives				
First cost, each	$44,000	$47,500	$54,000	$53,000
Weight, tons (2000 lb.)	125	125	160	160
Average efficiency, locomotive wheels to trolley, %	85	85	79	81
Maintenance per locomotive per mile, cents	4	4	8	5
Motor Cars (Complete)				
First cost, each	$12,000	$13,500	$20,000	.....
Weight, tons (2000 lb.)	43	44	84	.....
Average efficiency, wheels to trolley	82	81	73	.....
Maintenance per car mile, cents	3	2.2	3.5	.....

TABLE 2 GENERAL DATA FOR CARS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Number of cars	15	15	18
Seating capacity, passengers	80	80	80
Distance between stops, miles	3	3	3
Schedule speed, miles per hour	33	33	33
Maximum speed, miles per hour	48	48	55
Weight each car, tons (2000 lb.)	35	36	43
Car miles per day	3000	3000	3000
Miles per car in service per day	300	300	300
Miles per car per day, average[2]	200	200	166
Estimated maintenance per car mile, cents			
a Electrical	0.70	0.77	1.50
b Mechanical	1.00	1.00	1.25
Total car barn expense	1.70	1.77	2.75
Amperes starting car	520	280	75
Amperes running car	174	94	24
Kilowatt hours per car mile at car	2.8	2.88	3.78
Cost each car complete	$10,500	$11,500	$17,000

TABLE 3 SUB-STATIONS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Number of sub-stations	9	4	2
Estimated momentary demand			
Cars starting	1	1	2
Cars running	1	1	0
Peak load, kilowatts	416	445	670
Average load, each sub-station, kilowatts	52	120	275
Size each unit, kilowatts	300	300	300
Number of units	2	2	3
Load factor (machines in service)	0.17	0.40	0.46
Average efficiency	0.78	0.87	0.96
Cost each sub-station complete	$24,000	$26,400	$10,000

DATA SHEET.

a Profile of road.

b Transportation required, *i.e.*, weight of trains or seating capacity of cars.

c Frequency of trains.

d Length of individual runs or distance between stops.

e Schedule required.

f Length of railway to be electrified.

In the selection of the electrical system best adapted to a particular set of conditions there are three items to be considered: (*a*) sub-stations, (*b*) contact conductors, (*c*) rolling stock. A comparison of these items determines the relative economic values of the systems. There are certain features under each of these items which may properly be examined. For trunk line service the values in Table 1 will be found within reasonable limits for the usual requirements.

We will consider briefly the effect of changes in the Data Sheet items:

a Profile: From a level country to a limiting grade of one or one and one-half per cent there will be little difference in the relative values of the systems. With steeper grades the conditions will be more favorable for alternating current.

b Traffic Requirements: Heavy individual train units favor the alternating-current system with exception of the locomotives; light trains or multiple-unit operation favor the direct-current system.

c Frequency of Trains: Infrequent service with a relatively small number of locomotives favors the alternating-current, frequent service the direct-current. With increase in number of trains, the direct-current systems gain relatively faster than the alternating-current in economy of operation, due to relatively decreased substation operation, increased substation efficiency, and lower cost of equipment maintenance. It is therefore well to consider what the ultimate traffic density may be and select the system best suited to meet these requirements.

d, e Distance between Stops and Schedule Required: Variations in these will not affect the relative value of systems unless extreme requirements, such as high schedule speed with short runs, make the use of direct current imperative.

f Length of Road: For a similar character of service throughout, the railroad may be of any length without affecting the relative desirability of the various systems. What is suitable for the first fifty miles will be equally suitable for any extension.

An examination of these variables will show that a change in the conditions to be met will radically change the relative economic value of the systems of electrification.

The single-phase system, by reason of the apparent simplicity of its elements and the utilization of higher potential for the

1 On twelve American single-phase roads the average miles per day called for on the published time tables, divided by the number of cars owned, is 133; on four 1200-volt roads which have been operating over a year this number is 237, the larger number of alternating-current cars being required on account of the fact that a greater number are necessarily held in the barn for inspection and maintenance purposes. This explains why in the table above eighteen alternating-current cars are assumed and fifteen direct-current cars.

contact conductor than is possible with direct current, is admittedly very attractive. There is the other side of the question, that it is impossible to build a single-phase commutating motor comparable in first cost and maintenance with a direct-current motor. Over this subject of alternating-current single-phase vs. direct-current systems there has been a great deal of controversy. It is our opinion that comparative results obtained up to the present time are in favor of direct-current.

Desirable as would be a standard system for all classes of service, we cannot hope to establish such a standard should it impose an additional expense without adequate return. A summing up of the elements of each electrical system will generally lead to a definite showing of which system is most desirable to meet specific conditions. For trunk line service a higher potential than 600 volts will unquestionably be used; 1,200 volts direct-current will prove economical in some cases, but a still higher voltage is required to provide economically for the heavier intermittent service. Whether this potential will be 1,800 or 2,400 volts direct-current or 11,000 volts alternating current cannot be settled arbitrarily.

TABLE 4 FEEDER COPPER REQUIREMENTS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Maximum momentary demand midway between sub-stations.			
Cars starting	1	1	2
Cars running	0	1	0
Amperes	520	374	150
Distance between sub-stations	11.8	28	58.6
Equivalent stub-end feed	2.9	7	16.6
Feeder required additional to 4/0 trolley	4/0	1/0	none
Cost overhead construction per mile, including both trolley and feeder	$2300	$2100	$1900

Bonding taken as $400 per mile of track.

Transmission line taken in each case as $840 per mile of track and assumed to run entire length of right of way.

Power house: No power house is included, but it is assumed that power is purchased at the power station bus at one cent per kw.-hr and fed at any convenient point into the transmission line.

TABLE 5 POWER CONSUMPTION

	600 v. D. C.	1200 v. D. C.	6600 v. A.C.
Total kilowatt-hours per day at cars	8400	8650	11,400
Efficiency, secondary distribution	0.90	0.90	0.94
Sub-stations	0.78	0.87	0.96
Transmission line and power house step-up transformers	0.94	0.94	0.94
Combined efficiency	0.64	0.74	0.83
Kilowatt-hours per day at power house	13,100	11,700	13,400

TABLE 6 SUMMARY OF COSTS

First Costs

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	$ 84,000	$ 84,000	$ 84,000
Sub-stations	216,000	108,000	20,000
Secondary distribution	230,000	210,000	100,000
Bonding	40,000	40,000	40,000
Cars	150,000	172,500	380,000
Total	$720,000	$612,500	$694,000

Annual Fixed Charges

Depreciation	Life Years	Annuity 5%	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	20	30.34	$ 2,500	$ 2,500	$ 2,500
Sub-stations	20	30.34	6,500	3,200	600
Secondary distribution	15	46.34	10,600	9,700	8,800
Bonding	10	79.50	3,200	3,200	3,200
Cars (A. C.)	12	62.83			22,600
Cars (D. C.)	15	46.34	6,900	8,000	
Total Depreciation			$29,700	$26,600	$37,700
Interest and Taxes					
Interest 5%, taxes 1.5% of cost of electrical material			$46,000	$39,800	$45,000
Insurance					
1.5% of sub-station and car costs			$ 5,500	$ 4,200	$ 5,700
Total fixed charges			$81,200	$70,600	$88,400

Annual Operation and Maintenance

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	$ 3,500	$ 3,500	$ 3,500
Sub-stations	17,000	7,600	500
Secondary distribution, including bonds	9,000	9,000	10,000
Cars	18,500	19,500	30,100
Power at one cent per kw.-hr	47,800	42,700	49,000
Additional cost maintenance of track and roadway, shops and supervision, due to heavier cars and more expert supervision required for the single-phase			10,900
Total	$95,800	$82,300	$104,000

TABLE 7 COMPARISON OF COST OF SYSTEMS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
1 First cost	$710,000	$612,500	$694,000
2 Fixed charges	$ 81,200	$ 70,600	$ 88,400
3 Operation and maintenance	95,800	82,300	104,000
4 Annual cost (Item 2 plus Item 3)	$176,000	$152,900	$192,400
Based on 1,095,000 car miles per year, additional annual charge per car mile above the cost for 1200 volts, in cents	2.1	0	3.6

INTERURBAN RAILWAYS.

Let us consider the interurban railway situation in the United States, particularly in regard to the various available schemes of electrification. These are, 600-volt direct-current, 1,200-volt direct-current, and single-phase, the three-phase being debarred on account of the complications of the necessary double overhead-distribution system.

The application of single-phase to new projects has been practically abandoned, there having been but one or two new installations in the last three years. This arrested development of a system which for a short time held forth considerable promise has been brought about by a general recognition of its limitations. Experience has shown these to be:

a Excessive weight of rolling stock.
b Excessive cost of rolling stock.
c High cost of equipment maintenance.
d Increased power consumption.
e Rapid depreciation of motor.
f Rapid depreciation of car bodies and trucks.
g Increased cost of maintaining track and road-way.

Moreover it is recognized that any interurban road in the United States must be capable of operating over existing city tracks from 600-volt direct-current trolley, a condition which hampers the single-phase system on account of increased complications in the control system.

For interurban railways a potential of 1,200-volt direct-current has been selected, because with the motors wound for 600 volts the car may be operated at the same speed from either 600 or 1,200-volt trolley, by connecting the motors all in parallel for 600-volt operation, and two in series with two groups in parallel on a 1,200-volt section.

To show clearly the relative merits of the systems we have made an analysis of an interurban railroad 100 miles long with cars in each direction every hour. This condition represents practically the minimum car requirements in the United States, and is therefore favorable to the single-phase. It is obvious that any increase in traffic density will be relatively more favorable to the direct-current system on account of the lower first cost of cars, lower car maintenance and relatively lower cost of sub-station operation.

Assume a typical interurban condition:

a Profile: rolling country.
b Transportation required: passenger cars to seat fifty passengers and having baggage compartment, or the equivalent of sixty passengers without baggage compartment.
c Frequency of trains: one every hour in each direction.
d Average distance between stops: three miles.
e Schedule speed: thirty-three miles per hour.
f Length of road: 100 miles.
g To operate on existing 600-volt city tracks.

The general data required are approximated in Tables 2 to 7.

There will be an additional cost of operation and maintenance with the single-phase system for the items of track and roadway, due to additional weight of cars, car shop expenses in providing greater facilities for shop inspection and repairs, and greater skill in superintendence of equipment. In a number of instances this has been found to amount to several cents per car mile. A conservative estimate would require at least one cent per car mile to be added for these items.

The comparison in Table 7 brings out the fact that even for conditions selected as favorable to the single-phase system, the 600-volt direct-current system is the more

economical considering operation, maintenance and fixed charges. An examination of the elements which enter into the first cost and operation of a system will show at once that as the density of traffic increases there is a rapid gain in the relative advantage of the direct-current over the single-phase system.

CONCLUSION.

The saving effected by the 1,200-volt direct-current system is so marked that a great increase in the adoption of this potential for this class of interurban railroading may be anticipated.

Reliability of operation is of the greatest importance, not only to the public but to the operating company, and in this respect the electric motor with its simpler construction, even though the general service is supplied from a central power station, has proved its superiority over the steam locomotive.

The electrical equipment of motor cars and locomotive is exposed to a large extent to dirt, water and snow, and not being particularly convenient for inspection, it usually receives less attention than the apparatus in the power station and substations. It is the custom on many roads to give the equipments a regular inspection once in a thousand or fifteen hundred miles, depending on experience, and to dismantle them for a thorough overhauling once a year. The character of the rolling stock equipment is a factor of far more importance to the reliability of the service than is often appreciated.

The multiple-unit idea, to which electric service is so well adapted, was utilized in the design of the Mallet type of steam locomotive where the driving engines of two practically separate locomotives are supplied with steam from a single boiler. Mallet locomotives have been built having a weight of 441,000 pounds on the drivers, the boiler having over 5,800 square feet of heating surface and a grate area of 100 square feet. To fire properly a locomotive of this capacity is difficult, and unlike the electric locomotive, its effectiveness depends on the steam from its own particular boiler.

With existing road clearances the steam locomotive unit, controlled by a single engineer, seems to have reached nearly the limit of power. The power of a steam locomotive being limited by the capacity of its boiler, an increase in speed can be secured only by a proportional reduction in tractive force. The electric locomotive on the other hand, is supplied with practically unlimited power from an independent power station, and can maintain a speed and tractive force that would be impracticable with a steam locomotive. The application of electric locomotives to passenger and freight service will result in faster schedules with equal or even heavier trains than are at present handled by steam locomotives.

Since the electric locomotive is equipped with a number of independent motor units, controlled by one engineer from a single master controller, it makes no difference, considering the complete locomotive as a machine, whether it be built as a single unit, or as two or three units having the same total weight on the drivers. For convenience in operation and repairs, it is probable that a single electric locomotive unit will be limited to a weight between 200,000 and 300,000 pounds on the drivers, even when built for the heaviest service. There are electric locomotives now under consideration which as single units will exert a maximum tractive effort of 90,000 pounds and which will be capable of maintaining a tractive effort of 35,000 pounds at a speed of thirty miles per hour.

Many of the terminal and tunnel electrifications have been brought about from the desire to do away with the danger and nuisance caused by smoke and gas. The elimination of smoke has also an economic aspect in the electrification of terminal stations, in permitting material improvement in the character and value of railway buildings. The Quai d'Orsay terminal of the Paris-Orleans Railway in Paris, which has been in operation since May, 1900, was the first instance where a steam railway profited by this feature of electrification.

Economy in operation will be secured by proportioning the number of cars in a train to the traffic required during different hours of the day. The patronage on which the gross receipts depend will be much encouraged by providing a service with short intervals between trains.

The author desires to express his thanks to C. E. Eveleth for his assistance in the preparation of this paper.

THE ELECTRIFICATION OF TRUNK LINES.

BY L. B. POMEROY.

It may be stated at the outset that whatever system of electrification is adopted, a very large outlay has to be faced and no case for electrification can be made out unless an increase in net receipts can be secured sufficient to more than pay interest on the extra capital involved. This increase may be brought about either by decreasing the working expenses for the same service, by so modifying the service as to bring in a greater revenue, or by a combination of these.

However, there is hardly a steam road in existence today which does not have divisions or sections, where distinctly local traffic can be handled more profitably by light, comparatively frequent electric service, than as now, with heavy steam trains. Both steam and electric service can be operated over the same tracks without detriment or embarrassment to either. In so doing each kind of service would be appropriately handled in a manner best suited to the conditions of each.

The fundamental principle, based on the present state of the art, seems to be that if you cannot accomplish something by means of electricity that is now impossible by steam traction, there is nothing to justify the change; the mere substitution of one kind of power for another, merely to obtain the same result, is not commercially warranted.

There are certain inherent advantages in electrical operation that have shown up very well, because the increase in business has absorbed the increased interest account, but these cases hardly apply to trunk line conditions as the law of induced travel has no bearing on freight train operation, the principal business of trunk line roads.

In heavy work the limiting feature of the steam locomotive is the boiler, and the maximum adhesion can be utilized only at low speeds. For example, a 2-8-0 locomotive with 180,000 pounds on the drivers, has a tractive force, at ten miles per hour, of about 40,000 pounds or 4.5 to 1. At thirty miles per hour the tractive force becomes 13,250 pounds or 30.2 to 1. As tractive force governs the tonnage hauled, the ability of the electric locomotive to utilize almost indefinitely power proportional to the maximum adhesion and produce a drawbar pull entirely independent of the critical speed of a steam locomotive, as limited by the boiler, is a marked feature.

In heavy grade work the ability to increase the speed shows up favorably to the electric locomotive as enlarging the capacity of a given section, but here also the business has to be sufficient to absorb the increase in fixed charges.

With steam locomotives a coal consumption, when running, of four to five pounds per indicated horsepower really means six or seven pounds at the rail, when the losses due to firing up, laying by in yards and sidings, blowing off at the pops, and consumption of the air pumps, are taken into account. Whereas, under electric operation, with an efficiency of sixty-five to seventy per cent between the power house and the rail, a coal consumption of four pounds per kilowatt-hour at the rail can be counted on.

The writer is informed that the Metropolitan Street Railway station (1903) with a forty per cent load factor, produced power, at the switchboard, at the rate of 4.7 mills per kilowatt-hour (or 3.5 mills per horsepower-hour), and with a load factor of fifty-five per cent which prevails in the winter time, the cost is at the rate of 4.43 and 3.3 mills respectively. These costs cover all expenses and repairs except fixed charges. The coal consumption is 2.9 pounds per kilowatt and 2.16 per horsepower-hour.

L. B. Stillwell is authority for the statement that the Interborough is producing power at the rate of 2.6 pounds of coal per kilowatt-hour or three pounds at the drawbar.

Another authority gives the following figures for the elevated roads for cost of power, $0.005 per kilowatt-hour at the switchboard, $0.0066 at the third rail shoes, or $0.0089 at the rims of the drivers. These figures are exceptional and hard to duplicate and as the fixed charges are not included, the writer would consider one and one-fourth cents per kilowatt-hour at the rail a conservative figure, and will use this cost in the following computations.

RELATIVE COST OF COAL FOR STEAM AND ELECTRIC OPERATION.

It may be fair to assume that where average coal is used, we can count on about $2.25 per ton for locomotive coal on the tender, while a much cheaper grade can be used in the power house, costing, with modern coal handling facilities, about $1.50 per ton. At this rate the relative difference in the cost of coal at the rail would be represented by the following figures:

Electric Power Station $\frac{2.5 \text{ lb.}}{50\% \text{ off.}} \times \$1.50 \ldots . \$\ 7.50$

Steam Locomotive $7 \times \$2.25 \ldots \ldots \ldots \ldots \ldots \$15.75$

or fifty per cent in favor of electricity. The following results of the Mersey Tunnel operation are pertinent: Under electric operation one ton of coal at $2.10 yields 2.29 ton miles at 22½ miles per hour, while with steam, one ton of coal, at $3.84 yields 2.21 ton miles at 17¾ miles per hour. The difference amounting to fifty-five per cent is in favor of the electric operation.

On mountain grades or in heavy freight service, where the boiler of the freight locomotive is forced to the limit, and the boilers are designed for this particular purpose, the showing is still more favorable to the electric side. Especially is this true when the steam locomotive is detained on side tracks for as long a period as it takes to make the run, which is very frequently the case, since under these conditions the cost for fuel becomes a larger proportion of the total operating expense. A 2-8-0 locomotive with fifty square feet of grate surface burns 300 pounds of coal per hour while lying on side tracks. Reports from Mallet locomotives indicate that from 600 to 800 pounds are burned per hour under the same conditions.

The cost of a unit of power with the steam locomotive becomes relatively higher under maximum than minimum boiler demands, while with electricity the cost per unit is at a uniform rate, whether working under extreme or light power demands.

For example:

Case 1. A consolidation (2-8-0) type lo-

comotive with 180,000 pounds on fifty-seven inch drivers, fifty square feet of grate surface, working under maximum conditions on a 1½ per cent grade, would burn 150 pounds of coal per square foot of grate surface per hour and evaporate from twelve to fifteen pounds of water per square foot of heating surface per hour. Under these conditions the cost per 1,000 ton miles would figure out as follows:

$$\frac{F\times\text{price per ton}\times R\times 1000}{2000\times\text{m.p.h.}\times E\times TF}=\text{Cost per 1,000 ton miles}$$

where F = coal per hour (150 lb. × 50 sq. ft. of grate surface).
R = resistance to be overcome [(grade per cent × 20) plus 6].
E = 80 per cent efficiency to cover losses such as cleaning fires, idle time while under steam, cylinder condensation, air pump consumption, etc.
TF = tractive force, in this case 180,000 lb. on drivers ÷ 4.5 = 40,000 lb.

Substituting these values, the formula becomes

$$\frac{7{,}500\text{ lb.}\times\$2.85\times 36\times 1{,}000}{2{,}000\times 10\times 80\%\times 40{,}000}=\$1.20$$

If the same service is handled by electric locomotives the cost on a similar basis becomes: R × (watt hr. per ton mile) × 1,000 tons × price per kw. at the rail

$$=\frac{36\times 2\times 1{,}000\times\$0.01\frac{1}{4}}{1{,}000}=\$0.90$$

If locomotive coal is taken at $1.70 per ton (the price in eastern Pennsylvania for low grade soft coal), the cost for coal for locomotives under the foregoing conditions would be:

(a) Steam, $\frac{\$1.20\times 1.70}{2.85}=\$0.716$

(b) Electric current reduced to 1c per kw. hour at the rail:

$$\frac{0.90\times 1c}{1\frac{1}{4}c}=\$0.72$$

SAVINGS CLAIMED FOR ELECTRIFICATION.

In view of the foregoing the following extract from an article by C. L. De Muralt will be of interest. The figures are from the annual report of 1903 of the roads named.

COST OF OPERATING TRUNK LINES.

	P. R. R.	N. Y. C.
Fuel for locomotives	$6,000,135	$4,635,877
Water for locomotives	335,286	295,583
Other spplies for locomotives	382,548	334,673
Wages: Engine men and roundhouse men	5,716,848	4,928,443
Other trainmen	4,442,127	2,991,335
Switchmen, flagmen and watchmen	3,900,427	2,511,552
Other expenses of conducting transportation	14,540,542	11,607,538
Repair to locomotives	4,412,983	3,608,972
Repairs other equipment	10,674,726	5,661,992
Repairs roadbed	8,542,935	6,145,341
Repairs structures	4,122,018	2,454,691
General expenses	1,858,319	1,786,494
	$64,928,894	$46,962,491

Mr. De Muralt then applies the figures found during the course of his investigation, which would lead to the following reductions if electricity was adopted as a motive power.

	P. R. R.	N. Y. C.
Fuel 10 per cent	$ 600.013	$ 463,388
Water saved entirely	335,286	295,583
Other supplies 50 per cent	191,274	167,336
Wages, engine men, etc., 25 per cent	1,429,212	1,207,361
Repair to locomotives	2,206,492	1,804,486
Total amount saved	$4,762,277	$3,942,154

The saving in water alone capitalized at five per cent equals $6,750,000 for the former and nearly $6,000,000 for the latter road. As large as these alleged savings are, yet they would not amount to more than two and one-half to three per cent on the necessary increase in capital to electrify the roads on which the foregoing savings apply.

While the first cost for power stations and electric equipment represents a large outlay, yet such items as the cost for repairs of locomotives and shops, expensive hostlering at terminals, coaling and water stations, and the incidental labor charge and repairs thereto will, in the aggregate, be materially reduced. The comparative saving in repairs will be indicated by the following figures:

Repairs.	Steam	Electric
Boiler	20%	0%
Running gear	20%	20%
Machinery	30%	15%
Lagging and painting	12%	5%
Smoke box	5%	0
Tender	13%	0
	100%	40%

POWER STATION CAPACITY.

The impression is quite prevalent that if 100 steam locomotives are required to operate a certain division, if operated electrically, a power station capacity the equivalent of 100 locomotives would be necessary, whereas the generator capacity, barring the installation of spare units, would be of such size as to meet the average load. This average can be determined by laying down a train sheet, from which the load at any hour in the day can be seen and the peaks located.

For ordinary computations the number of trains to provide for is, approximately:

$$\frac{\text{The total train miles per hour}}{\text{Mean speed}}$$

This formula is the result of cancellation from the following:

(a) h. p. days ÷ Aggregate h. p.

That is:

(b) $\dfrac{5{,}280\times(\text{Dis. miles})\times(\text{No. trains})\times(\text{Tons})\times R}{47{,}520{,}000\text{ ft. lbs. in 1 day}}$

$$\div\frac{\text{Tons}\times R\times\text{m.p.h.}}{375}$$

R = resistance due to gravity, + resistance due to speed, + curve resistance. Transposing and cancelling:

(c) $\dfrac{\text{Dis. miles}\times\text{No. trains}}{24\times\text{m.p.h.}}$

For illustration take a typical case: Distance 183 miles.

LOAD.

37 Freight Trains at 15 m. p. h.
22 Expresses at 50 m. p. h.
21 Locals at 30 m. p. h.

80 Trains total.

AVERAGE SPEED.

37 × 15 m. p. h. = 555
22 × 50 m. p. h. = 1,100
21 × 30 m. p. h. = 630
80 2,285

2,285 ÷ 80 = 28 average m. p. h.

$$\frac{80\text{ trains}\times 183\text{ miles}}{24\text{ hr.}\times 28\text{ m. p. h}}=22\text{ trains.}$$

SOME ADVANTAGES OF ELECTRIC LOCOMOTIVES.

In the annual report of the P. R. R. (1903) the president states "That the congested condition of your system has brought about a large increase in the ton mile cost, which for 1903 was twenty-five per cent greater than for 1899. In order to prevent the increase in ton mile cost, it is necessary to move freight trains faster in places where traffic is dense, and for such purposes the electric locomotive is most efficient."

With steam locomotives the most economical average speed, for freight service, is twelve to fifteen miles per hour, where there is ample track space for the free movement of trains. With a dense traffic this free movement can only be obtained by a higher speed and if the large train tonnage be maintained, more horsepower is required of the engine and boiler. It is difficult to increase the size of steam freight locomotives without resorting to the Mallet compound articulated type, and here we have the equivalent of two locomotives in one machine.

With the electric locomotive it is possible to develop a much greater horsepower and a large percentage of overload at the time when needed and do it more economically than with steam. The New York Central electric locomotive has a maximum peak horsepower of 3,000, which is twenty-five per cent above normal. This maximum is about double the power which can be obtained from the New York Central standard Atlantic (4-4-2) type locomotive. Similar proportions can be obtained for electric freight locomotives and their size and power are not limited by boiler capacity. If the steam locomotive is capable of developing 30,000 tractive force at the drawbar at twelve miles per hour or

$$\frac{30{,}000\times 12\text{ m. p. h.}}{375}=960\text{ h. p.}$$

and it is required to increase the speed of the train to twenty miles per hour and maintain the same tonnage, then 1,600 horsepower will be required, which means the employment of a much larger locomotive or double heading.

The advantage of the overload capacity on short mountain grades or for strategic peaks is one of the strong points in favor of the electric machine and would make electric operation applicable to special cases rather than a universal substitute, in the broad light of commercial considerations.

GENERAL CONCLUSIONS.

Our conclusion, from this survey of the situation, is that the rapid development of suburban passenger traction by electricity will require large power houses at large cities and these can gradually be made sufficient for working the line on further stretches in each direction, handling congested terminals, or used where commercially practicable, until it may be desirable to electrify the entire division.

Electric operation as compared with steam shows to greatest advantage in urban and suburban passenger service. Here, if multiple unit trains are employed, so that a considerable fraction of the total weight is carried on the driving wheels, thus permitting a high rate of acceleration to be used, a schedule speed quite impracticable in steam operation can be maintained. Moreover, a more frequent service can be given without a proportional increase in expense, whilst in times of light traffic small trains can be run, the energy consumption per train in such service being almost in proportion to the number of coaches. The law of induced travel, however, applies to urban and suburban passenger service, but does not hold for trunk lines and especially freight service.

President Harahan of the Illinois Central reports the results of the investigation that has been made relative to the proposed electrification in the following words:

"Our suburban traffic is the only service which would in any degree be adapted to electric operation, but even in this particular service it can be readily shown to be unjustifiable at the present time. I submit below a statement of the results which are estimated to accrue if the entire suburban service were electrified, compared with the present steam operation:

"Results of Operation of Suburban Business at Chicago for Fiscal Year ending June 30, 1909:	
Gross earnings	$1,056,446
Operating expenses (82.9%) plus taxes	946,734
Net revenue	$ 109,712
"Estimated Results Under Electrification:	
Gross earnings	$1,056,446
Operating expenses (66%)	$697,254
Taxes	74,427
	$771,681
Net revenue (electric operation)	$284,765
Net revenue (steam operation)	109,712
Increase	$175,053
Estimated cost of electrification	$8,000,000
Interest and depreciation 10%	$800,000
Saving in operation under electrification	175,003
Deficit	$624,947

"Our suburban traffic is not sufficiently dense to warrant the expense necessary to electrify these lines, and it is evident from the foregoing figures that even under electrification there would not be an increase in traffic sufficiently large to offset the annual loss from operation. It simply proves that under present conditions of cost of electrification of steam railways, where it means a replacement of a plant already installed, and serving the purpose, it is not justifiable to electrify either in whole or in part your Chicago terminals at this time."

The suburban district of the Illinois Central covers about fifty miles of road and carries in round numbers 15,000,000 suburban passengers per annum, or an average of 41,150 per day, or 1,700 per hour. An increase of 100 per cent in earnings would not enable the road to break even.

New York Telephone and Telegraph Companies Under Public Service Commission.

Governor Hughes has signed the bill to amend the public service commission law, in relation to telegraph and telephone lines and companies in the State of New York. Among the principal features of this enactment are the following:

The jurisdiction, supervision, powers and duties of the Public Service Commission in the second district extend to every telephone and telegraph line which lies wholly within the State of New York and that part within the State of New York of every telephone and telegraph line which lies partly within and partly without the State of New York and to the persons or corporations owning, operating or leasing such line.

Corporations formed to do business under the provisions of this enactment are subject to its provisions, although no property may have been acquired, business transacted or franchises exercised.

The enactment provides regulation as to adequacy of service; for rates that shall be just and reasonable and not more than allowed by law or by order of the Commission. No special rate, drawback, rebate or other method may be used with respect to communication by telegraph or telephone. No telegraph corporation or telephone corporation shall give any undue advantage to any person, corporation or locality, or subject any particular person, corporation or locality to any disadvantage in any respect whatsoever.

Upon the expiration of contracts in force at the date this article takes effect, or of rates or schedules of rates subsequently filed with the Commission, the Commission shall have power, in its discretion, to direct that such contracts shall be terminated.

Every telegraph and every telephone corporation shall print and file with the Commission schedules showing all rates, rentals and charges for all classes of service both upon its own and leased lines. These schedules shall be kept open for public inspection, and the Commission shall have the power to prescribe the form of such schedules.

Unless the Commission otherwise orders no change shall be made in rates except after thirty days' notice to the Commission. The Commission may allow changes in rates without requiring thirty days' notice, under such conditions as it may prescribe.

No telegraph or telephone corporation, subject to the provision of this enactment, shall, directly or indirectly, give any free or reduced service, or any free pass or frank for the transmission of messages by telephone or telegraph between points within the State of New York, except to its officers, employees, agents, pensioners, surgeons, physicians, attorneys-at-law and their families; to persons or corporations exclusively engaged in charitable and eleemosynary work and ministers of religion; to officers and employees of other telegraph corporations and telephone corporations and street railroad corporations. This will not, however, apply to State, Municipal, or Federal contracts.

Violations of the provisions of this enactment shall constitute cause for action upon the part of the person or corporation affected. If the court shall find that any act or omission was willful it may in its discretion fix a reasonable counsel or attorney's fee, which fee shall be taxed and collected as a part of the costs in the action.

The Commission shall have power over telephone and telegraph corporations to examine and keep informed as to their general condition, capitalization, their franchises and the manner in which their lines and property are leased, operated or managed, conducted and operated with respect to the adequacy of and accommodation afforded by their service and also with respect to the safety and security of their lives and property, and with respect to the compliance with all provisions of law, orders of the Commission, franchises and charter requirements.

The Commission and each Commissioner shall have power to examine all books, contracts, records, documents and papers, and by subpoena duces tecum to compel the production thereof, or of duly verified copies.

Every corporation shall file with the Commission an annual report at a time and covering the yearly period fixed by the Commission: The Commission shall prescribe the form of such report and the character of the information to be contained therein. Failure to make report within specified time will incur a penalty of one hundred dollars of each and every day of continued default. Such forfeiture shall be recovered in an action brought by the Commission in the name of the people of the State of New York. The Commission may, however, when deemed advisable, exempt any corporation from the necessity of filing annual report until further order of the Commission. The Commission may establish a system of account to be used by the corporations subject to its jurisdiction.

Complaint may be made to the Commission by any person or corporation aggrieved, by petition or complaint in writing. The Commission may investigate such charges in such manner and by such means as it shall deem proper, and take such action within its powers as the facts in its judgment justify.

The Commission may investigate any rate, charge, toll or rental and determine the just and reasonable charge, and also may inquire into the adequacy of service and determine and regulate such adequacy of service.

The Commission may order or require any two or more corporations whose lines form a continuous line of communication, or could be made to do so by the construction and maintenance of suitable connections or transfer of messages at common points, between different localities which are not reached by the line of either company alone, to establish through lines within the state, and shall have the power to establish the same and fix the joint rate for service thereover.

No corporation hereafter formed shall begin construction of its line without permission and approval of the Commission and its certificate of public necessity.

Any corporation which shall violate any provision of this article or which fails, omits or neglects to obey, observe or comply with any order or any direction or requirement of the Commission, shall forfeit to the people of the State of New York, not to exceed the sum of one thousand dollars for each and every offense.

This act shall take effect September first, nineteen hundred and ten.

In his memorandum accompanying his approval of the measure the Governor says:

"This bill places telegraph corporations, and telephone corporations (except those having property used in the public service within the State of value not exceeding $10,000) under the jurisdiction of the Public Service Commission, and thus extends to this class of corporations the established policy of the State.

"The bill as a whole should be approved. There are certain matters of importance, however, with respect to which the bill is open to criticism.

"First. The entire jurisdiction over these companies is placed with the Public Service Commission of the Second District. The convenience of administration would be promoted, in my judgment, if the jurisdiction, particularly with respect to telephone corporations, were divided between the two Commissions as in the case of railroads, and gas and electrical corporations.

"Second. The bill does not give a sufficiently wide control over the issue of securities. It provides: 'No telegraph corporation or telephone corporation shall be required, however, to apply to the Commission for authority to issue stocks, bonds, notes or other evidence of indebtedness except for the acquisition of property, the construction, completion, extension or improvement of its facilities, or the improvement or maintenance of its service within the state, or the discharge or refunding of obligations, or reimbursement of moneys actually expended for such purposes.' The issues of securities by domestic corporations of this class should be subject to the approval of the Public Service Commission whether the money is to be expended within or without the State. With respect to corporations of its own creation, this State should exercise complete supervision. As to this second matter particularly, amendatory legislation should be had."

Meeting of the Indiana Municipal League.

The twentieth annual meeting of the Indiana Municipal League was held in Richmond, Ind., June 21 and 22. Joseph T. McNary, of Logansport, president, in calling the meeting to order, said it was gratifying to know that over 200 delegates had registered, indicating the largest attendance in the history of the league. The report of the officers showed the organization to be in a prosperous condition.

The first topic for discussion was "Commission Form of Government," and was opened by John MacVicar, a member of the commission in Des Moines, Ia. Mr. MacVicar gave many reasons why he deemed the commission form of government the best for cities, declaring that ideal conditions are now prevailing in Des Moines, where the system was given a fair trial. He advised Indiana cities to adopt the commission form of government as quickly as possible.

"Is it Profitable for Cities to Own and Operate Their Own Electric Light, Water Works, Gas and Heating Plants, and Should Cities Grant Franchises for the Same?" was the chief subject discussed during the first session of the second day's convention. To Andrew M. Gardner, city attorney of Richmond, had been assigned the task of opening the discussion. Mr.

Gardner restricted his discussion exclusively to electric light plants and went on record as being a strong advocate of municipal ownership of such plants.

R. A. Johnson, of Logansport, said he had gathered some data which indicated that there have been more failures than successes in municipal enterprises in Indiana. However, he said there has been fewer failures in recent years and he believes that municipal ownership and operation of public utilities will soon become general in small communities. He said many of the failures in the past were due to bad law and political interferences.

Lawrence Becker, mayor of Hammond, argued that no city should be allowed to grant a franchise without referring the question to a vote of the people.

"Public Utilities Commission" was strongly opposed by Robert Ashe, of Richmond, who believes that a public utilities commission is a pernicious kind of legislation. He said that Richmond had more electric power consumers out of a population of 24,000 inhabitants than the city of Worcester, Mass., with its 80,000 inhabitants. The latter city has a utilities commission.

Track elevation was a subject thoroughly discussed and the conclusion reached that it was the only solution for public safety and would have to come regardless of cost.

The next annual meeting of the league will be held in Crawfordsville. L. M. Darrow, mayor of Laporte, was elected president, and F. B. Robison, of Crawfordsville, secretary.

Electric Men Celebrate.

Over four hundred men representing all the electrical interests of Greater Pittsburg celebrated on Saturday, June 25 last, at Bradford Park, Pittsburg. The occasion was the annual outing of the Pittsburg Boosters' Club. Arriving at the grove, each car was met by the reception committee and band, the latter under the direction of Oscar R. Lepper. Following a lunch, a number of athletic contests were carried through, the sports concluding with an exciting ball game.

The real feature of the gathering was the splendid feeling of good fellowship prevailing, for which the outings and meetings of the Electric Boosters' Club is noted. The party returned to the city in special cars in the early evening.

All credit for the success of the outing is due to the executive committee, C. B. Cushing, O. R. Rombaugh, Ludwig Hommel, O. R. Lepper and H. B. Parke.

Among the companies represented were the following: Frick & Lindsay Company; Ludwig Hommel & Company; Doubleday-Hill Electric Company; Western Electric Company; Charles L. Kiewert Company; Westinghouse Electric and Manufacturing Company; Crocker-Wheeler Company; General Electric Company; Sprague Electric Company; Cutler Hammer Manufacturing Company; Allegheny County Light Company; Pittsburg Railways Company; McCreery & Company; Craig Electric Company; Franklin Electric Construction Company; Union Electric Company; Miller-Owens Electric Company; Iron City Electric Company; Gellatly & Company; Robbins Electric Company; W. T. McCullough Electric Company; Stimple & Ward Company; Springer & Patterson; Pittsburg Gas and Electric Fixture Company; C. S. Knowles; Youngstown Consolidated Gas and Electric Company; United Electric Light Company; Crouse-Hinds Company; Pass & Seymour; Benjamin Electric Company; Morganstern Electric Company; American Conduit Manufacturing Company; Bossert Company; Hart Manufacturing Company.

Ohio Electrical Association; Programme of Sixteenth Annual Convention.

The sixteenth annual convention of the Ohio Electrical Association will be held at Cedar Point, Ohio, July 26, 27 and 28.

The following programme has been arranged:

"Experience with Series Tungsten Lamps for Street Lighting," by Claude C. Smith, Bradford, Ohio; C. C. Custer, Piqua, Ohio, and Frank Jackley, Eaton, Ohio.

"What Progress Is Being Made in the Introduction of Electric Vehicles in Ohio," by J. T. Kermode, Cleveland Illuminating Company, Cleveland, Ohio.

"Turbine Troubles," by Frank Brosius, Columbus Railway and Light Company, Columbus, Ohio.

"Outline of an Equitable Power Rate," by B. H. Gardner, Dayton Lighting Company, Dayton, Ohio.

"Methods of Maintaining Electric Meter Accuracy," by John Gilmartin, Toledo Railway and Light Company.

"Central-Station Facts and Factors," by J. R. Cravath, Chicago, Ill.

"Motors for Single-Phase Circuits as They Are Today," by Prof. F. C. Caldweli, Ohio State University, Columbus, Ohio.

"Low Pressure Turbines and Their Operations," by W. C. Anderson, Canton Electric Company, Canton, Ohio.

"Methods to Be Pursued in Getting New Business in Cities of 15,000 and Less," by L. A. Petit, Jr., Middletown Lighting Company, Middletown, Ohio.

"Best Methods to Be Followed in Purchasing Station Apparatus," by R. J. Feathers, Columbus Railway and Light Company, Columbus, Ohio.

"Tungsten Lamps vs. Central-Station Earnings," by E. L. Booth, Bellaire Light and Power Company, Bellaire, Ohio.

Theodore N. Vail Interviewed.

Theodore N. Vail, president of the American Telephone and Telegraph Company, who recently returned from Europe on the *Adriatic*, said that while in London he had attended several conferences between heads of several of the transatlantic cable companies.

"These conferences," said Mr. Vail, "were mainly for the betterment of the service. We have been studying ways and means whereby the transatlantic cable service may be improved, especially for bankers and brokers. Several innovations were suggested, and quite a number of suggested improvements are now under consideration. I cannot yet say what may be adopted in this regard."

Asked if there were any truth in the report that the American Telegraph and Telephone Company was about to absorb the Anglo-American Company, or that the two companies were about to amalgamate, Mr. Vail said: "No, there is no absolute truth in that statement. I presume such a rumor got abroad from the fact that the heads of the Anglo-American Company and myself were frequently in conference over other matters, namely, those previously outlined for the betterment of the service."

Mr. Vail also denied that at present there was any movement on foot for the adoption of night cable letter, giving 500 per cent in words for the minimum of day cost, as has been put in force by the telegraph companies here.

New Electrical and Mechanical Apparatus and Appliances.

The Boynton Vacuum Pump.

When the word "vacuum" was mentioned a generation ago, it carried with it the idea of a rather primitive mercury pump in a musty laboratory. Geissler and Crookes had utilized this means for obtaining moderate and high vacua, and the latter had announced a "fourth state of matter" as the result of his experiments. The pump of Sprengel was perfected by his successors and developed a very high vacuum. But it was not until the advent of the incandescent electric lamp that an evacuated chamber became a commonplace thing, and in our own day it is becoming almost as common in the form of the Dewar flask or thermos bottle.

The modern requirements of the lamp bulb, the thermos bottle and the Roentgen ray tube have created a demand for a pump which shall not only give a good vacuum, but give it quickly. In other words, the pump must combine a large volume capacity with the ability to exhaust to a very low pressure. This requirement the mercury pump has failed to meet.

Many attempts have been made to construct a mechanical or piston pump which shall answer this purpose, and although great difficulties are encountered, the problem is one which only required careful study and the proper application of mechanical principles to solve.

The latest claimant for honors in this field of endeavor is illustrated in Fig. 1. This shows a five-cylinder pump with horizontal shaft at the bottom of the frame. Each cylinder is five inches in diameter and eight inches long, giving a volume of 157 cubic inches. The air coming from the vessel to be exhausted is pumped successively through the upper ends of the five cylinders and then out into the atmosphere. The lower ends of the five cylinders are connected similarly in series, and may be used to exhaust a second vessel or left to simply exhaust themselves. Since there is a vacuum on each side of the piston, there is little tendency for leakage.

Square hemp packing is used in the pistons, and, by reason of the approximate balance of pressure above and below, the packing is run so loosely that piston and piston-rod, when disconnected from the cross-head, are easily moved by hand. Hence there is very little wear on the packing and it can be run several months without renewal. When necessary piston and rod are removed and returned to place without disturbing the packing. The pistons are solid and contain no valves or air passages.

From the above it is evident that there is nothing in the stuffing-box that grips the rod. The rod is like any other ordinary piston-rod and its fit in the stuffing-box is strictly a sliding fit. The possibility of making such a fitting air-tight may be doubted, yet it is claimed that this effect is accomplished by simple and inexpensive means.

The inlet and outlet at each end of each cylinder is controlled by a valve, as shown in Fig. 2. The fitting which actuates the valve is covered with a seal of mercury in order to make it air-tight, and this also acts as a detective for the prompt location of leaks.

The valves are opened and closed by positive motion. They are operated by cams having a square drop. This is shown in Fig. 3. Valve seats are integral with cylinder casting and are located about three-fourths inch from interior cylinder wall. The valve is of cold-rolled steel and is ground to its seat. The automatic valve which opens for the final exhaust into the atmosphere is backed up by a poppet valve to prevent this cylinder back-filling with air at the commencement of the stroke. The clearance at the end of the cylinder is one millimeter.

Pistons in adjacent cylinders have contrary motion and the sum of the volumes above the two pistons is always equal to the volume of one cylinder. Hence there is simply a transference of air from cylinder to cylinder with no accompanying compression and no heating. There is a slight heating of the cylinder from which the final exhaust is made due to compression necessary to lift the poppet valve.

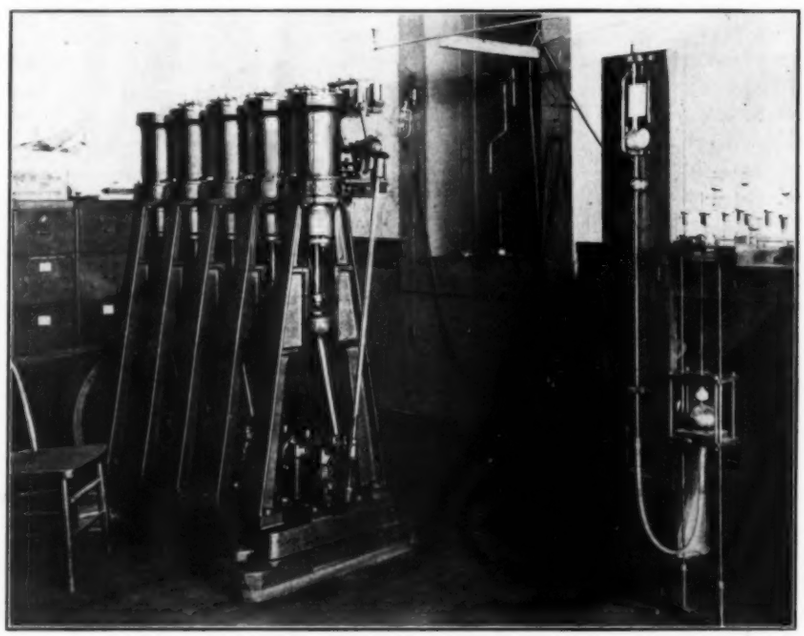


FIG. 1.—THE BOYNTON VACUUM PUMP.

The machine stands sixty-four inches in height and occupies fifty-one by twenty-five inches floor space. The two cylinders with highest vacuum are phosphor-bronze throughout, with a cast-iron lining for wear. The remaining three cylinders are of cast-iron. Otherwise all the cylinders, valves, valve-ways, etc., are alike in construction. No liquid is used in the cylinder to complete clearance. The pump is run at a speed of seventy revolutions

per minute. Fewer cylinders may be used where not so high a vacuum is required.

The general character and quality of construction are about the same as in the ordinary steam-engine. One of the distinctive features of the machine is that parts subject to shocks and strains have been made sufficiently strong.

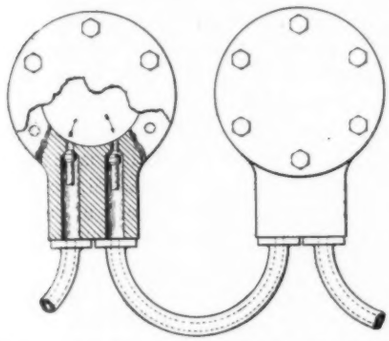


FIG. 2.—VALVES AND CYLINDER CONNECTIONS.

The rapidity of operation of this pump is shown by the following test. An X-ray tube, having a volume of 126 cubic inches, was connected to the pump by glass tubing, the total connected volume being 136 cubic inches. A watch was read at the time of starting the pump, and at definite times thereafter the pressure was read by means of a McLeod gauge. At the end

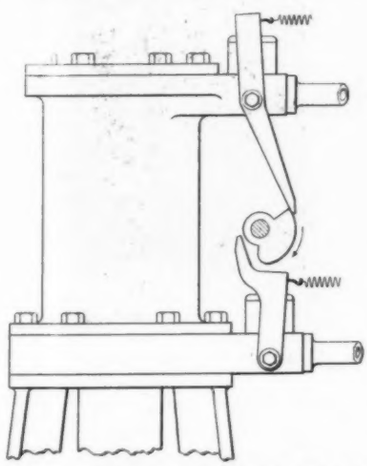


FIG. 3.—CAM FOR OPERATING VALVES.

of two minutes the pressure was about 0.0001 atmosphere, after five minutes it was 0.000004 atmosphere. After fifteen minutes the electric discharge would no longer pass through the tube, the gauge indicating 0.000002 atmosphere.

This machine was designed and constructed by C. H. Boynton, 414 North State Street, Chicago, who has applied for patents. It is expected to find a wide application among manufacturers of incandescent lamps, X-ray tubes, vacuum bottles for heat insulation, etc.

The Paragon Ground Cone.

The efficiency of grounding devices has been a much discussed question and a number of interesting experiments and tests have been made for the purpose of arriving at definite conclusions. So far, however, no reliable data are available, for the reason that the tests necessarily require a considerable length of time. Most of the resistance of any ground, of course, occurs in the immediate neighborhood of the ground plate, and anything that tends to improve the condition of the soil improves the chances for a good ground. Ground resistance is naturally an important feature and depends not only on the moisture of the soil but on the season, on the geological formations, and also on the construction of the ground plate or grounding device. It is admitted by all that it is difficult to obtain a satisfactory ground, and recently many efforts have been directed toward improving the ground device itself.

In the absence of any authoritative information, engineers admittedly have been guided largely by "common sense," and this is the basis on which the Paragon ground cone has been devised. It is made of pure sheet copper perforated with seventy-five perforations to the square inch. It is filled with pea-sized charcoal, a hollow pure copper cable running through its entire length, which is soldered securely to the bottom and which extends about three or four inches above its top. The perforations not only allow the charcoal to absorb moisture, thus keeping the soil around the cone permanently damp, but they also furnish a much larger discharge area than the surfaces of the cone itself; not only the lateral surfaces but also the superficial area of each perfortaion being taken into consideration. As previously mentioned, most of the resistance of the ground occurs in the immediate neighborhood of the ground plate, and that moisture in this adjacent is most important; therefore, it is believed that the moisture absorbing and holding qualities of the charcoal will prove a most important factor in keeping up efficiency of the cone as a ground.

The perforations of the cone also reduce to a minimum the cone's electrostatic capacity, as the sharp edges of the perforations act as discharge points. The hollow copper cable is furnished so that the ground wire may be run into it and slipped to the very bottom of the cone. A pull on the ground wire makes the cable lace itself tightly around the wire on the same principle as the action of the ordinary "cable come-along." A little solder around the top of the cable keeps the wires together and insures perfect contact between the ground wire and the cone.

The cone is tipped with a solid point of copper. The ground cone is easily, economically and quickly installed and requires practically no attention or maintenance after installation. It can be buried to any depth by simply boring a hole with an ordinary post hole auger and dropping the cone in. The manufacturer recommends that charcoal or coke be tamped around the cone partly to protect it from possible chemical action of the soil and partly to increase the moisture in the soil directly surrounding the cone.

The cones are made in two sizes, each size being made in two gauges of metal—a light gauge for use with telephone and telegraph systems and the heavier gauge for use with lighting or power systems.

The cones, which are being used to a very considerable extent for grounding the frames of motors or generators, lightning arresters, transformer secondaries, transformer cases, three-wire neutrals, protection of trolley circuits, etc., are manufactured by the Paragon Selling Company, 60 Fifth Avenue, Chicago, Ill.

A New Amperemeter.

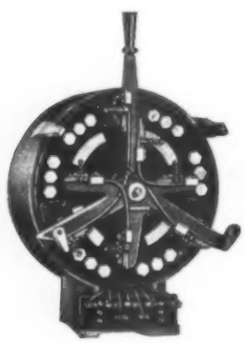
A new amperemeter for continuous and alternating currents has been brought out by Isenthal & Company, London, Eng. The operation of the instrument is based on methods in which the current to be measured is caused to heat up thermojunctions, thus setting up indirectly a current which actuates the movement of the instrument. The novelty in the present instrument consists in the arrangement adopted for combining the action of a number of thermojunctions in such a manner that thermocurrents are produced of sufficient magnitude to deflect

an ordinary pivoted moving-coil instrument.

The thermocouples are placed in the four arms of a Wheatstone bridge, the movement being connected to two opposite corners of the bridge, and the leads carrying the current that is to be measured to the remaining corners. The polarities of the thermocouples are so chosen that when the bridge is warmed up by the passage of a current the electromotive forces set up in the four arms conspire so as to send a current through the movement. The arms of the bridge are adjusted so that the thermoelectric current passes through the movement without entering the external circuit, and the current from the external source passes through the thermocouples without affecting the galvanometer.

A Motor-Driven Plow in Mexico.

The practical demonstration of the operations of an electrical plow which took place upon the San Antonio de Coapa hacienda near Mexico City, Mex., has aroused much interest in agricultural and electrical circles. The plow was of the Benrather type and was shown by Enrique Schoendube. It was driven by a seventy-horsepower motor which in the demonstration tests obtained its electric power from the

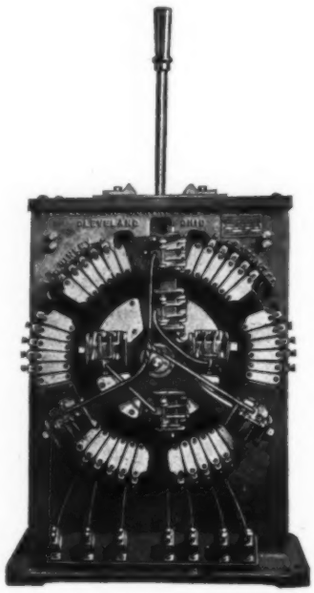


MOTOR CONTROLLER.

transmission line of the Mexican Light and Power Company. The motor wagon was placed on one side of the field and an anchor wagon at the other side. The two were connected by cable upon which rode the plow frame. The double frame was equipped with twelve gang-plows, the motor and anchor wagons being advanced automatically at the end of each trip of the plow across the field. Two men operate the outfit, one on the motor and the other on the plow.

A New Line of Alternating-Current Controllers.

Until quite recently direct-current motors were used almost exclusively for operating electrically-driven cranes and mill machinery. However, the flexibility and ease with which alternating current may be transmitted has, within the past few years, resulted in a large and increasing use of alternating-current motors for these applications.



MOTOR CONTROLLER.

For this character of work the series-wound direct-current motor has the very desirable characteristic of high starting torque. In alternating-current motors this feature is more nearly found in the slip-ring type of motor than in the squirrel-cage type. Therefore for the operation of cranes, mill tables and other reversing work of a similar nature, the development of the alternating-current motor has leaned heavily towards the use of the slip-ring motor. Speed and torque control are obtained by inserting and varying resistance in the secondary winding of the motor.

The Electric Controller and Manufacturing Company, of Cleveland, Ohio, has developed a comprehensive line of manually-operated controllers for slip-ring alternating-current motors from one to 100 horsepower. These controllers follow as closely as possible in design and construction the direct-current controllers which this company has been manufacturing for years. In fact, wearing parts on the alternating-current and direct-current controllers are interchangeable to a large extent.

The controllers illustrated are for use in connection with reversing slip-ring motors, either two-phase or three-phase. The resistance is entirely self-contained, it being necessary to connect only seven leads to the controller. Where heavy currents are to be handled, cast grid resistance is employed, and unusual precautions have been taken to insure installation which will be permanently satisfactory.

All contacts are mounted on a vertical slate face so that mill dust cannot settle between segments, causing short-circuits. All contacts are of heavy copper and are reversible. The use of screws or bolts with special threads has been avoided, and so far as possible, wearing parts have been designed so that they can be manufactured by the user in his own repair shop.

The operation of all of these controllers is by a lever motion which the manufacturers consider advantageous for crane and mill service. Although the cuts illustrate controllers for slip-ring motors only, yet the Electric Controller and Manufacturing Company has furnished and is prepared to supply controllers for squirrel-cage motors and alternating-current commutating motors.

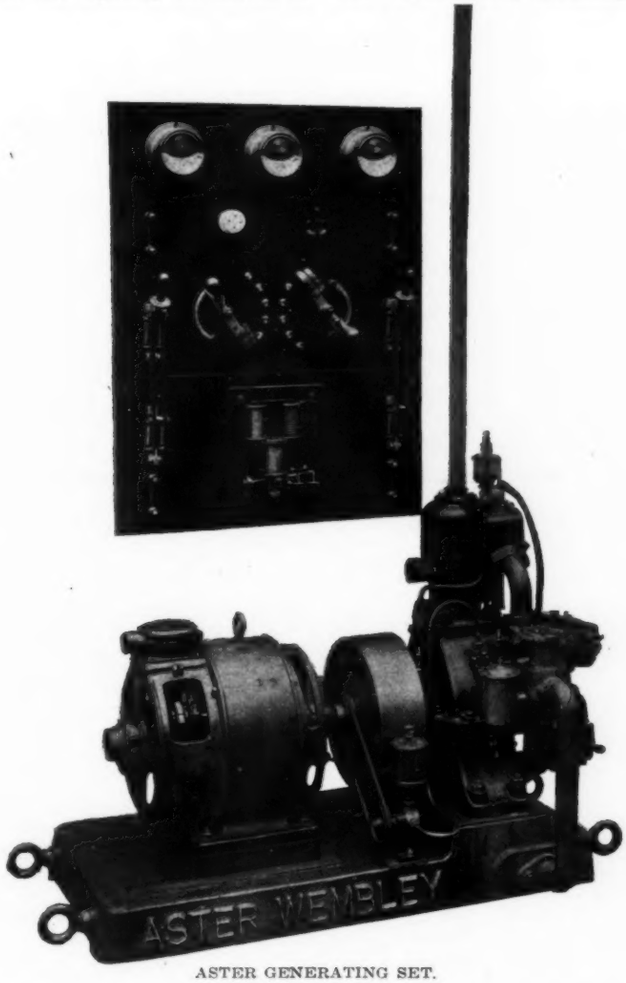
MOTOR CONTROLLER.

H. L. Doherty & Company, of New York, have acquired all the property of the Meridian (Miss.) Light and Railway Company, including the street railway and the electric lighting and gas system of the city.

Isolated Lighting Plants.

The remarkable development made in isolated electric-lighting plants has lowered their cost to such an appreciable extent that their use is becoming quite general, particularly in country residences and club houses. Safety, convenience and cleanliness are also factors worthy of consideration in comparing the various lighting systems.

The Aster Engineering Company, Limited, Wembley, Eng., is placing on the market the lighting set shown in the accompanying illustration, which embodies many features worthy of note.



ASTER GENERATING SET.

The Aster generating set, shown herewith, consists of a high-speed gasoline engine fitted with mechanically operated valves and Bosch high-tension magneto ignition. The engine is carefully balanced and is direct connected to a shunt-wound dynamo mounted on the same bedplate. This generator has an output of 1,000 watts and is capable of lighting 100 ten-candlepower or 60 sixteen-candlepower lamps.

The battery included in this set consists of a series of thirteen cells and according to the size desired, is capable of lighting forty-five or sixty-five ten-candlepower, twenty-five-volt metallic-filament lamps for a period of five hours, or a smaller or greater number of lamps for a proportionately longer or shorter period.

The switchboard consists of an enameled slate panel mounted on a wrought-iron frame and fitted with the necessary instruments, including an automatic cut-out to protect the dynamo and battery from careless usage.

These generator sets are also adaptable to other industrial uses, the engine being capable of operating numerous machines commonly found in the country.

The New York Public Service Commission reports accidents during May as 4,709, as against 4,512 in May, 1909 and 5,152 in May, 1908. The killed were thirty-two in each year.

A New German Alloy.

Consul-General Richard Guenther makes the following summarized translation from the *Frankfurter Zeitung* concerning new metal alloys in Germany:

Visitors to the Aeronautic Exhibition at Frankfort last year will remember the electron metal, manufactured by the Chemical Factory Griesheim, which received a prize and attracted great interest on account of its low specific weight. The great technical importance of such alloys that combine a low specific weight with a high resisting power induced many experts to make further experiments in this interesting field. Walter Ruebel, a civil engineer, the inventor of "Reubel" bronze, has made an alloy which will become a strong competitor of electron. Its main ingredient is also the light metal magnesium, which, in its pure state, is entirely unfit for metallurgical purposes, as it is rather soft and little resistant to atmospheric and chemical influences. However, magnesium loses these bad properties almost entirely even if only small quantities of other metals are added to it. Zinc, copper, and aluminum are added in this new invention in varying quantities. It is advisable not to add more than ten per cent and not less than four per cent to the magnesium. A fine-grained, homogeneous alloy of considerable strength and low specific gravity results. This new alloy is of importance in constructing air ships. A Zeppelin air ship, with its mechanical parts made of electron metal or of this new alloy, weighs three and one-half to four tons less than were it constructed from the materials formerly used.

New Car-Disinfecting Apparatus.

Consular Agent George A. Makinson, of Sorau, describes a new disinfecting apparatus for passenger cars recently installed at the Potsdam yards of the Prussian State Railways:

The former method of cleaning cars infected with vermin cost $85 per car, while by the new method whole railway trains can be cleaned in a few hours at a cost of $8.50 per carriage. The new apparatus consists of a steel tube laid parallel on the ground and having a diameter of sixteen feet four inches and a length of seventy-five feet four inches. When a carriage is to be disinfected all doors and windows are

opened and the carriage pushed into the apparatus. The tube is then closed and made airtight and the air heated by means of steam pipes to 122 degrees Fahrenheit. Then, as the temperature in the tube is constantly increased, the air is pumped out until the atmospheric pressure falls to thirteen and one-half pounds per square inch. This draws all life from the vermin, also from the spawn under the cushions or behind the woodwork, and their death made absolutely certain. When it is desired to cleanse the carriage not only of vermin, but also of infectious germs, an evaporator filled with formalin is placed in the center of the tube. A picture of the new apparatus may be seen at the Bureau of Manufactures, Washington, D. C.

Waage Electric Soldering Tool.

A handy tool in the form of a soldering iron, possessing numerous commendable features, is being placed on the market by the Waage Electric Company, 674 West Madison Street, Chicago, Ill.

A view of this tool is shown in the accompanying illustration. Its chief claim to popularity lies in its adaptability to instantaneous use and the uniform heat that is maintained. Low current consumption is also assured by the manufacturers, who state that in thirty-five days the cost of the tool is saved.

An advantage of the electric soldering tool over other types lies in the fact that no time is lost in changing irons, also no poor joints are obtained on account of the iron being too cold.

WAAGE ELECTRIC SOLDERING TOOL.

The Waage electric soldering tool is constructed on scientific principles with no unnecessary parts to make it complete. The heat is developed wholly within the forged copper working tip, which is constructed of extra heavy and durable material. This tip, it is said, will stand considerable filing and may be easily replaced at a reasonable cost. The heating element is also easily replaced and is manufactured to give from 800 to 1,500 hours of actual service.

This tool is made in four sizes, ranging in current consumption from forty to 140 watts. Six feet of cord is furnished with each tool.

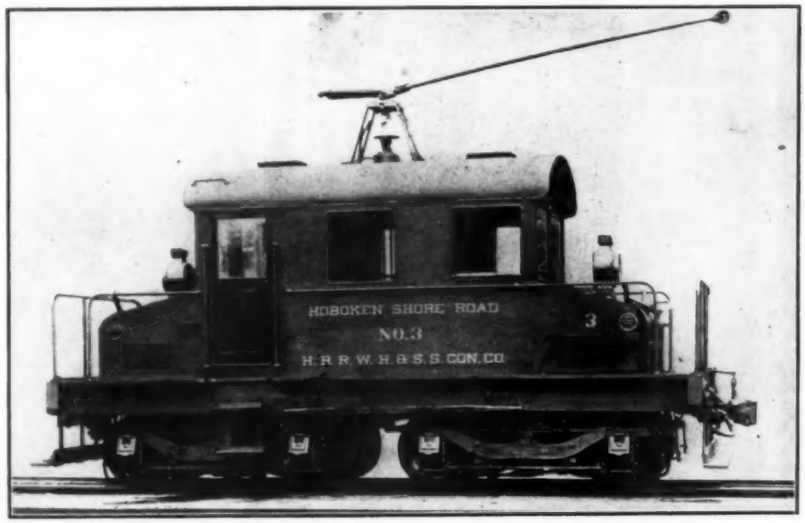
Electric Switching Locomotive Excites Favorable Comment.

The Hoboken Railroad, Warehouse and Steamship Company has had in operation since May, 1906, a sixty-ton electric switching locomotive whose remarkably continuous and economical performance under varying and severe load conditions has caused many very favorable comments in railroad circles. This locomotive has not only supplied the demand made most urgently by operating men that the service be perfectly reliable, but has been operated continuously at a maintenance cost that is exceedingly low.

Since the electric locomotive was placed in operation four years ago there has not been replaced a single contact on the switch group or a contact on the master switches or reverser. On the control apparatus nothing other than two tips on the live switch has been replaced. The brushes that are in the motors at the present time have been operating fourteen months, and give indications of a longer life. No trouble has been experienced with broken brushes. Except that there has been replaced one pinion which was broken when a lock washer dropped into the gears, no repairs on the motor have been necessary.

The cost of inspection and cleaning has been practically nothing. Every Saturday morning the man operating the locomotive makes an inspection of the equipment. With compressed air he blows out the motor and the various parts of the control apparatus, and cleans any part that may need it with a piece of cloth. This work is not charged to maintenance, as the operator in doing it is simply filling in his time. No extra time is needed for maintenance or inspection.

The locomotive has a running and a starting drawbar pull of 14,500 pounds and 30,000 pounds respectively, and has a normal speed of twelve miles an hour. It has four 100-horsepower slow-speed motors; a hand-operated unit-switch control, and Westinghouse air brakes with a D-4 compressor. The electrical equipment was furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; the mechanical parts, the steel cab and the trucks were built by the Baldwin Locomotive Works. The Hoboken Company stated that there never has been a time when the locomotive refused to work or would not do the work required of it. It averages twelve hours a day of shunting service very nearly every day in the year.



ELECTRIC SWITCHING LOCOMOTIVE.

The Mobility of Ions.

At the meeting of the Philosophical Society of Cambridge (Eng.), on May 23, a paper was read by A. L. Hughes on "The Mobilities of the Ions Produced in Air by Ultra-Violet Light." The experiments show that air is ionized by ultra-violet light of very short wave-length. The mobilities of the ions so produced are found to be identical with the mobilities of the ions produced by X-rays.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, JUNE 17.—For some years now the action of municipalities, owning electricity works, in undertaking the wiring and fitting of consumers' premises—or at any rate, those municipalities that have Parliamentary powers so to do—has created no little feeling on the part of wiring contractors who object to this rate-aided competition. The matter came more or less to a head last year when the contractors succeeded, in the House of Lords, in inserting words in the Electricity Supply Act limiting corporations to carrying out such work through a contractor, but not otherwise. The municipalities retaliated by threatening to block the whole bill in the House of Commons, and in order not to jeopardize the many good points of the bill, the Board of Trade withdrew the clause altogether. Consequently, we now have the position that some municipalities are allowed, under special acts of Parliament, while others are not allowed, in the absence of such powers, to wire and fit premises, even if there is not a contractor in the town. The controversy has been revived this week in a rather unexpected form. While an action by the Electrical Contractors' Association against the Leicester Corporation for illegally wiring consumers' premises and selling electrical apparatus commenced in the High Courts, municipal electrical engineers at their annual conference were denouncing the wiring contractor with more than the usual vigor. The development of business-getting departments is rapidly coming to be accepted as a necessity by central-station engineers, and the more they go into the question the more they allege they discover that the contractors' aim is mainly to put in as many lights as possible regardless of the expense to the consumer. It is quite truly urged that the improvement in the sale of heaters, cookers, and auxiliary electrical apparatus generally dates from the recent business activities of the municipalities themselves. On the other hand, the decrease in price synchronizes with this, so that the contractor is not wholly to blame. Anyway, I think it most likely that a determined effort will now be made on the part of municipalities to secure the universal grant of electric wiring powers.

The action against the Leicester Corporation will apparently turn upon a clause of the Electric Lighting Act of 1882, which nobody hitherto has regarded as carrying the supply authority beyond the consumer's meter. In any event, the action is almost certain to go to the House of Lords, for a most important point of principle is at stake. Should the Leicester Corporation be correct in its views, then from the year 1880, all electric supply authorities in Great Britain have had powers which none have dared put into force, and it clears the whole ground once for all. Viewed from a purely business point of view, it hardly seems that it should be otherwise. Should the contractors prevail, then, on the absence of a special act of Parliament, each local authority desiring to wire premises, must promote a private bill in Parliament, and face the expense of a vigorous opposition by the Contractors' Association.

A considerable change of opinion is taking place as to the actual economy in installing exhaust-steam turbines in reciprocating-engine central-stations as a means of increasing the output. Even the makers of these turbines realize that something in the nature of a fashion has set in, and that they are being put in under wrong circumstances in some cases. More than one leading central-station engineer has worked out figures for actual extensions which have showed superiority in favor of ordinary turbines. Mr. Ferranti, who has been studying the subject for some time, has come to the conclusion that from the point of view of costs of generation, it would pay to scrap existing reciprocating engine plant, and put down an entirely new station, but he realizes the difficulty of a municipality, at any rate, dealing with the financial side. He suggests, however, that first-class turbine builders, in such circumstances, should quote a price for constructing a new power house including the purchase of the old one, which they could sell as scrap iron. On the other hand, there is a considerable body of opinion that it is unwise to be always striving after reducing costs of production when this involves burdening the capital account unduly.

A movement is being made towards an amalgamation of the various organizations connected with the electrical industry in so far as these relate to trade, generation of electricity, consulting work, manufacture, etc. The idea is to arrive at one electrical trade organization, which will be so sectionalized that it can deal with any matter appertaining to the electrical trade. A committee has been formed to go into the matter. At present we have a contractor's association, manufacturers' association, cable-makers' association, and so on, all working independently of, and sometimes against, each other.

Owing to the heavy cost of cables and services, it has been seriously suggested that the Board of Trade should double the standard pressure in consumers' premises, at present 220 volts, and so reduce the amount of copper necessary. Others who do not think the Board of Trade would be likely to do any such thing, suggest that the distribution pressure up to the consumers' premises should be considerably increased, even up to 1,000 volts, and transformers placed on the premises to reduce down to anything the consumer might wish according to the voltage of his lamps. These views are being expressed in consequence of the difficulty, on account of cost of services, in dealing with the small-house supply-problem, in competition with gas.

The Bournemouth Corporation has definitely decided to abandon the conduit system in that city and to apply to the Board of Trade for permission to install the trolley system. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, JUNE 17.—There has been going on a considerable change as regards the distribution of current for the city of Paris. According to the old regime, the underground mains were in the hands of six different companies, but the municipal council decided to make a change, and in 1907 it gave the entire concession to a new enterprise, the Compagnie Parisienne. There is to be, however, a transition period before the new company finally takes charge of the current mains and the various central stations, and this will last until the end of 1913. Meanwhile the six companies which are continuing to operate the mains have consolidated and are making some extensions in the mains and also in the matter of sub-stations, at the same time establishing a uniform tariff of fourteen cents per kilowatt-hour for lighting current and six cents for motor current. During the transition period the programme calls for the building of two ceneral stations having a combined output of 75,000 kilowatts. Five new substations are now completed. The different systems of mains in the city will be fed on the three and five-wire systems, also by single-phase and two-phase current.

In order to connect the different railroad stations in the city of Toulouse, there has been developed a project for electric tramway lines which the municipal council is now considering. A subsidy of a million francs is expected from the Department for this purpose. Bids have also been advertised for public and private lighting, and it has been decided to substitute flaming arcs for the present type of lamps.

In Russia there is a project on foot for an electric traction line between Sebastopol and Jalta. At Baku, the well-known oil production center, the municipality is undertaking improvements which will involve an extensive use of current for public lighting. It is also decided to adopt electric traction on the present street railways. The town of Reval is taking up a project for erecting a central station of some size.

A power line is shortly to be erected so as to connect the electric stations of Turin with the locality of San Mauro.

Electrical interests are to be well represented at the coming Congress of Frigorific Industries which will be held at Vienna from October 6 to 11. The first congress was held at Paris last year and was a great success.

There is a movement of some scope in Switzerland in electric traction matters concerning the application of motors upon standard gauge railroads. The Rhatsche Balin railroad administration has lately decided to adopt electric traction upon the Engadine system of lines, both upon the present sections and also upon the extensions which are to be made. Current will be obtained from the Brusio plant. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., JUNE 25.—In the matter of the street lighting arbitration of the city of Hamilton, Ont., the award of the arbitrator gives the city a reduction of $11 per lamp per year on the price paid the Cataract Power Company.

In one of the hottest contests ever held in the city of Windsor, Ont., the application of the Electric Distributing Company for a franchise to bring Niagara power into Windsor, was granted by the ratepayers of the city by a narrow majority.

The Maritime Coal, Railway and Power Company, of Amherst, Nova Scotia, which is developing electricity at the pit mouth, has taken over the Canada Electric Company, which furnishes the town

of Amherst with light. This plant will be supplied with power from the electrical plant of the Maritime Company, to which has just been added another unit, giving 750 additional horsepower.

The town of Montcalmville, a suburban town of the city of Quebec, has just awarded a thirty-years' franchise to the Quebec Railway, Light and Power Company to extend its electric car line along St. Cyrille Street. Work on the extension will be commenced at once and the road will be continued as far as Sillery.

Work on the transmission line of the Ontario Hydroelectric Commission to the city of Toronto is fast nearing completion. It is anticipated that power will be turned on by the first of August next. The wires from Guelph to Dundas are strung, and several gangs of workmen are now engaged in the work between Dundas and Niagara Falls. All the towers between London and Woodstock are in position, and the wires will at once be strung.

There are eight wireless telegraph stations situated on the coast of British Columbia, owned and operated by the Dominion government, which are now in commission and in a position to handle commercial business. These stations are: Victoria, Point Gray (Vancouver), Cape Lazo Pachena, Estevan, Triangle Island, Ikeda Head, Queen Charlotte Island and Prince Rupert. The following are the tolls charged: To and from ships, $1.20 first ten words and twelve cents for each additional word, which is the maximum rate allowed by the Berlin convention. Rates for vessels on the Vancouver, Seattle service, twenty-five cents. For local business, the rate is from fifty cents to seventy-five cents. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

POWER PROJECT IN NORTH CAROLINA.—A company headed by A. M. Kistler, of Morgantown, and J. D. Pitts, of Glen Alpine, N. C., is working out plans for the development of a water power on the Catawba River near the latter place, which is a village six miles from Morgantown. A preliminary survey of the proposed development is now being made and it is estimated that approximately 2,000 horsepower of electricity can be produced. The town of Morgantown, for power and lights, would consume between 1,200 and 1,500 horsepower.

HARTFORD LIGHT COMPANY TO ENLARGE PLANT.—The Hartford Electric Light Company, of Hartford, Conn., has contracted with Westinghouse, Church, Kerr & Company, and with the General Electric Company for an addition to the Dutch Point power plant, which will double its producing capacity, and will cost, complete, approximately $400,000. The present building is to be enlarged about fifty per cent by an addition of similar construction to that now occupied by the power plant. This will be of concrete and steel foundation and brick superstructure, the total cost to be about $75,000. Two horizontal Curtis turbines, rated at about 5,000 kilowatts each, will be installed by the General Electric Company, and this will increase the present engine equipment by 100 per cent, making a total of about 25,000 horsepower. Additional boilers will give the necessary steam.

LIGHTING AND POWER.

(Special Correspondence.)

BEATRICE, NEB.—This city has voted bonds for waterworks and electric light purposes.

BELGRADE, NEB.—This city has voted $18,000 in bonds for electric light plant and waterworks.

SAN FRANCISCO, CAL.—The Mariposa Electric Power Company has filed application for voluntary dissolution. A.

DULUTH, MINN.—The Minnesota Canal and Power Company will shortly begin the construction of a power house. P.

OSSIAN, IOWA.—A franchise for the installation of an electric light and power plant has been granted to C. Miller & Sons, of Clermont. C.

REDMOND, ORE.—The Crook County Light and Power Company has been formed here for the purpose of installing an electric lighting plant. A.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company will run a power line between St. Croix Falls, Wis., and the Twin Cities. C.

SASKATOON, SASK.—The Saskatchewan Power Company will erect a power generating plant, twelve miles below the city, at a cost of $1,000,000. C.

VANCOUVER, B. C.—The Vancouver Power Company is planning the development of 100,000 horsepower electrical energy at a cost of $10,000,000. C.

VISALIA, CAL.—The Tulare County Power Company has been incorporated by J. J. Vosburg, C. H. Holley and H. H. Holley, with a capital stock of $1,000,000. A.

PORTLAND, ME.—The Agamenticus Electric Light Company has been incorporated by C. F. West and F. D. Marshall, of Portland, with a capital of $100,000.

MONMOUTH, ILL.—The Monmouth Public Service Company has closed a contract with the city for all-night lighting of the streets from August 1 to May 1. Z.

BRYAN, TEXAS.—The Bryan Ice, Light, Water and Power Company is doubling the capacity of its electric light plant here. The dynamo which is being installed has a capacity of 3,000 lights.

PRINCETON, CAL.—The Northern California Power Company is preparing to extend its lines from Hamilton City to Jacinto, where the power is to be used for the operation of irrigating pumps. A.

McFARLAND, CAL.—Ben. M. Maddox, president of the Mount Whitney Power & Electric Company, announces that a plant will be built here this year and will be in operation by February of next year. A.

ENOLA, PA.—On Thursday, June 23, the new street lights were turned on. A banquet was given in honor of the occasion and this was followed by a parade through the brilliantly illuminated streets.

PEORIA, ILL.—The Peoria Gas and Electric Company has elected the following officers: President, H. D. Walbridge; vice-president, B. C. Cobb; secretary, W. H. Brown, Peoria, and treasuser, A. D. Colvin. Z.

PORTLAND, ME.—The Prescott Gas and Electric Company, of Portland, has been incorporated to deal in gas and electricity, with a capital of $100,000. C. E. Eaton is president, and T. L. Croteau, treasurer.

GOLDHILL, ORE.—B. H. Harris, president of the Goldhill Railroad and Lumber Company, is about to install a power plant here. The electricity will be used to operate certain machinery of Mr. Harris's company. A.

CAMDEN, PA.—The Carbon Electric Company has been incorporated to manufacture coke gas, and electricity. The capital of the company is $500,000 and the incorporators are Charles L. Walton, Walter L. Bowen and H. G. H. Fan.

LONG BEACH, CAL.—C. J. Corbrey has come into control of the Long Beach Electrical Company, by purchasing the interest of W. H. Tidmarsh, inventor of an electrical fuse. Mr. Corbrey announces that the plant will be enlarged some time this year. A.

LAS VEGAS, N. M.—The Las Vegas Light and Power Company has been taken over by the Federal Light and Traction Company of New York, a corporation formed for the exclusive ownership of the light and power companies of Colorado, New Mexico and Arizona. A.

MONTGOMERY, N. Y.—The electric lighting equipment which is to be installed in this place will probably be ready for operation by the end of September. The contract, which has already been executed, provides for nineteen street lamps, at a cost of $16.00 per year for each. The contract is for three years.

FORT WORTH, TEX.—The city of Fort Worth is taking steps to enforce an ordinance passed two years ago requiring the electric companies to place their wires underground. The city is also considering the proposition of selling its lighting plant and contracting with the private companies for light. D.

KLAMATH FALLS, ORE.—C. S. and R. S. Moore, of this city, have purchased the interests of Alex Martin, Sr., H. V. Gates and E. R. Reams in the Klamath Light and Power Company. The Moore Brothers will operate this plant in conjunction with the one they own on the west side of the Link River. A.

COLUMBUS, IND.—The Commissioners of Bartholomew County have granted a perpetual franchise in East Columbus to the Columbus Gas and Light Company. The company will extend the service and make improvements in the plant. There is some doubt about the legality of the franchise because no time limit is stated. S.

DANBURY, CONN.—The Danbury & Bethel Gas and Electric Light Company is preparing to intsall in it power station a new steam turbine electric generator which will more than treble the capacity of the plant. Two additional 300-horsepower boilers will be added to the equipment, and the station will be enlarged.

TRENTON, N. J.—The Public Service Electric Company was incorporated here with an authorized capital stock of $15,000,000. The company is to manufacture and distribute electric power. The incorporators are Thomas N. McCarter, Edwin W. Hine and Dudley Farrand, all officers of the New Jersey Public Service Corporation.

MONTICELLO, IA.—The City Electric Light, Heat and Power Company, organized here a few weeks ago and capitalized at $30,000, has begun the erection of a new electric light plant. It will be operated by water power. The dam which is the best on the Maquoketa River, will be raised so that about 200 horsepower will be developed.

JONESBORO, IND.—The Trowbridge & Niverson Bonding Company, of Chicago, has purchased the stock held by the town of Jonesboro in the electric light and the water plant of that place and will make extensive improvement in the properties. New machinery and equipment will be added and a twenty-four-hour electric service installed. S.

BERKELEY, CAL.—The Great Western Power Company has obtained a thirty-five year franchise to supply power to this city. The application for the franchise has been under consideration by the council for two months and has twice been withdrawn for revision. Within three months, the power company will begin work on installing its system. A.

GRANGEVILLE, IDA.—The Grangeville Light and Power Company, which has been purchased by the Big Bend Light and Power Company, is under the management of Eugent Enloe, of Spokane, who announces that his company will, within the next three months, spend about $50,000 in enlarging the plant and extending its service lines to Cottonwood. A.

OVERTON, TENN.—The Livingston Light and Power Company has been incorporated with a capital stock of $15,000. The incorporators are H. E. Speyer, F. E. Bracey, D. W. Harmon, W. H. Estes and M. H. Hankins. The purpose of this company is to improve and develop the water power of rivers for generating, distributing and selling electricity.

NEWPORT, WASH.—The Northern Idaho and Montana Power Company, which operates electric light and power plants between Kalispell, Montana, and Newport, has made a contract with the Washington Waterpower Company of Spokane, to provide light and power for the cities of Newport, Sandpoint and the intervening territory. The contract is to run for ten years. A.

SAN FRANCISCO, CAL.—City Attorney Long has advised the Supervisors that the city has the legal power to erect an electric-light plant in Golden Gate Park and that such power must be exercised by the Park Commissioners in the absence of an ordinance granting this power to the Board of Public Works. Mr. Long holds that the plant can be used solely for furnishing the park with light. A.

ASHLAND, WIS.—The current has been turned on for the new electric lights recently installed in the east end of the city, and they are giving satisfaction. There are three lamps to every block and the avenues are much better lighted now than under the old gas-lamp system. The work on the rest of the new lights is progressing rapidly, and Ashland will soon be an exceptionally well-lighted city.

AUBURN, CAL.—The Bell Electric Company has notified the board of city trustees of Auburn that it will spend $3,000 in improving the street lighting system of the city. New lights will be put in in all parts of the city, and the trustees will be allowed to select the kind that will in their opinion give the best service. The lights will be placed on one circuit, so that they can be turned off at will.

SEYMOUR, IND.—The Seymour Public Service Company has incorporated capitalized at $100,000. The object of the corporation is to build, equip and establish a plant to supply the city of Seymour and the community adjacent thereto, so far as can be economically served, with electric light, heat (including hot water), steam and electrical heating and power. J. C. McReynolds, W. W. Layton, C. E. Layton and C. W. McReynolds, directors. S.

SPRINGFIELD, ILL.—The Springfield Light, Heat and Power Company has elected officers as follows: President H. B. Walbridge; first vice-president, B. C. Cobb; second vice-president, J. W. Bunn, Springfield; secretary, Harry T. Willett, Springfield; treasurer, E. L. Sturtevant; directors, J. C. Klaholt, H. K. Weber, B. R. Hieronymous, S. D. Scholes, J. F. Miller, all of Springfield, H. D. Walbridge, B. C. Cobb and C. M. Clark. Z.

SALT LAKE CITY, UTAH.—William H. Bancroft, president of the Utah Light and Railway Plant, has let a contract to Westinghouse, Church, Kerr and Company, of New York, for an 11,000-horsepower reserve station for his company. It will be located on the Jordan River and cost between $600,000 and $750,000. The plant will be installed to provide a continuous supply of electricity for lighting and power in Salt Lake and Ogden. A.

LAPORTE, IND.—The Childs-Hulswit Company of Grand Rapids, Mich., which concern has six branches, one of which is in Laporte, has absorbed the Laporte Electric Company by purchase. This deal means that the Laporte Electric Light plant and the Laporte Gas Light plant will be controlled by the Childs-Hulswit syndicate. A. J. Stahl, a large local stockholder, retains his interest in the Electric company. The consideration was $250,000. S.

CRAWFORDSVILLE, IND.—The city clerk and trustees of the municipal electric light and power plant are asking for bids for the installation of steam turbines, electric generators, steam boilers, mechanical stokers, motors and transformers, arc lamps and a large amount of other equipment in the new electric light and power plant now building by the city. The Esterline Engineering Company of Lafayette is superintending the construction of the plant. S.

CANTON, O.—The Canton Electric Company has announced that it will spend $400,000 for improvement to its power plant in East Seventh Street, within the next year or so, and that the construction of a $175,000 addition, a boiler room, will be begun immediately. An important feature of the improvement will be the construction of the steel smoke stack, 250 feet high, which it is said will be the tallest stack in this section of the country and one of the tallest of its type in the United States.

SEYMOUR, IND.—Stoughton A. Fletcher of Indianapolis, and Horace C. Stillwell of Anderson are preparing to let a contract for the construction of a waterpower, electric-generating plant to cost half a million dollars. A large dam will be built in White River and buildings erected installed with machinery to be used for creating current for light, heat and power purposes. The current will be used by the large stone quarries, the citizens of Bedford and the citizens of the vicinity within a radius of twenty miles. S.

SAN ANGELO, TEX.—The San Angelo Street Car Company has under consideration the extension of its street railway system to the southern and western portions of this city. Since the company was taken out of the hands of the receiver last fall, its business and revenues have greatly increased. In April, this year, 35,000 passengers were carried, and in May, 37,832 fares were collected, while in September, 1909, the number of passengers carried was only 8,000. Sam Crowther is now president of the company.

MILWAUKEE, WIS.—It has been announced by officials of the Milwaukee Electric Railway and Light Company that the Commerce Street power plant will be increased from 20,000 horsepower to 80,000. The new power will come from the installation of three mammoth steam turbines of 20,000 horsepower each, in the addition to the Commerce Street power house which will be built on the ground north of the present plant. Of this increased power, 20,000 horsepower will be ready for service by December 1. Of the remainder, 20,000 will be added in 1911, and 20,000 in 1912.

SANTIAGO, CUBA.—A hydroelectric power plant of 4,000 horsepower was installed in 1909 on the Maipo River near Santiago, at a cost of about $3,000,000. The plant will furnish light for the city and power for such industries as may require it. The Government has granted a German company a concession to install an electric power plant on the Aconcagua River in the vicinity of Los Andes. This plant will supply power to run the government railways between Valparaiso and Santiago, a distance of 114 miles, and also will provide light for the cities and towns along the way.

DURHAM, N. C.—This city has unanimously granted the petition of the Southern Power Company, presented by vice-president W. S. Lee and others, to carry in transmission lines. Mr. Lee states that the company hopes to reach the town within eight months, and that a steam plant of 10,000 horsepower may be built in Durham to supplement the transmitted current, and for emergencies should such arise. The location of the 10,000-horsepower steam turbine will be either in Greensboro or Durham, it is now understood. The company asks for a sixty-year franchise in Durham, and includes East and West Durham, at both which stations large cotton mills are in operation. L.

DOUGLAS, ARIZ.—Arrangements have been made for the Copper Queen Company, which operates a large smelter at Douglas, to construct a transmission line to the mines and mill of El Tigre Mining Company in El Tigre district, state of Sonora, Mexico, and furnish them with electric power. The line will be fifty miles long. The Copper Queen Company is already furnishing power for the street railway system here, in addition to the power for operating its own smelter. El Tigre Mining Company was investigating the situation with the view of erecting its own hydroelectric plant when it found an opportunity to enter into a contract with the Copper Queen Company for power. D.

MUSKOGEE, OKLA.—In order to vote a bond issue of $600,000 for the purpose of building a dam across the Grand River and equipping a power plant to furnish power to Muskogee and the surrounding towns, the city will ask the next legislature to pass a special act permitting it to vote the bond issue. As the city is now carrying a bonded indebtedness, and an additional bond issue of $600,000 would make the amount in excess of the limit allowed under the state laws without a special act of the legislature, this action is necessary. The power plant will be operated by the city and will greatly cheapen the cost of power. The dam will also furnish Muskogee with a gravity water supply. D.

ROCK HILL, S. C.—The board of public works of this city has closed a contract with B. Parks Rucker, electrical engineer, of Charlotte, N. C., for plans and specifications for a municipal lighting plant for Rock Hill, work on which will be begun immediately. The town has been contracting for its lighting with a private concern, the Rock Hill Water and Electric Company, but the lighting contract expiring, and the town and company being unable to reach an agreement as to terms for a new contract, the municipal lighting plant was determined upon, and steps taken for securing its installation at once. The town recently voted the sum of $285,000 for lights, water and sewerage, so that ample funds are available for prosecuting the new municipal undertaking. L.

MEXICO CITY, MEXICO.—The material for the proposed extension of the transmission line of the Mexican Light and Power Company to the Pachuca mining district, thirty-six miles, is being assembled and arrangements made for pushing the construction work. The line voltage from the Necaxa hydroelectric plant of the company will be 85,000. It is expected that the line will be finished early in August. The receiving station at Santa Gertrudis which is now under construction will not be finished until about the first of the coming year but this will not delay the introduction of power into the camp, it is announced. A temporary station will be established for giving power service throughout the district. The whole equipment will be on a scale to provide power considerably in excess of the current demanded. D.

ELECTRIC RAILWAYS.

(Special Correspondence.)

WATERLOO, IOWA.—Ground has been broken for a power house for the Waterloo, Cedar Falls & Northern, estimated to cost $300,000. It will be of steel and concrete and will have a capacity of 8,000 kilowatts. C.

EL PASO, TEX.—The El Paso Street Railway Company has applied for authority to increase its capital stock from $1,500,000 to $2,500,000, the proceeds of the new stock to be used in improvements and new equipment.

NEW HAVEN, CONN.—The Connecticut Company has taken out a municipal permit for the erection of trolley barns at the corner of Grant and Blatchley avenues. The structure will be of brick and steel, and the estimated cost is $20,000.

EUGENE, ORE.—The city council of Springfield at a recent meeting granted the Portland, Eugene & Eastern Railway Company the franchise for the construction of a street railway system in this city. Work on the big bridge across the Willamette River is being rushed.

SAN FRANCISCO, CAL.—A. J. Pon has been granted a twenty-five-year franchise for an electric street railroad along Gough from McAllister to Market Street. This road is the outcome of a protest of the Fillmore Street Improvement Club against the congested traffic on Fillmore Street. A.

FOREST CITY, S. D.—The Forest City and Mason City Railroad, with headquarters at Watertown, S. D., has been incorporated by Dr. Koto and C. Christofferson, of Forest City, for the construction of an electric line from Mason City, Iowa, to Forest City, S. D., a distance of thirty miles.

SWEETWATER, TEXAS.—C. M. McLain, G. E. Romsey and W. E. Barrow of Sweetwater have been granted a franchise by the city council for the construction of an electric street railway here. The promotors of the project must have at least three miles of track finished and in operation within two years. D.

FORT SMITH, ARK.—A movement has been started at Magnolia to establish an electric railway line from that town to the agricultural college, two miles north of the city. It is the intention of the promoters ultimately to exend the line from Magnolia to Magnesia and McNeil. The company that will undertake the enterprise is to be capitalized at $100,000.

NORWALK, OHIO.—The Shelby, Norwalk & Mansfield Electric Railway Company has closed a deal whereby cars will be run direct from Mansfield to Sandusky this summer. Heretofore cars were operated only as far as Shelby but the contract with the Mansfield & Shelby Traction Company will result in limited cars being put in service between Mansfield and Sandusky, in a short time. H.

LIMA, O.—The Western Ohio Railroad Company, with headquarters at Lima, and having $10,000 capital stock, has been incorporated to operate a trolley line between Dayton and Toledo and also connecting Wapakoneta, Celina, St. Marys and Laramie. The incorporators of the new line are Frank H. Ginn, Albert E. Green, Glenn M. Cummings, Grover Higgins, and John M. Garfield, all of Cleveland.

GARY, IND.—The officials of the Gary Interurban Railway have refused an offer of $500,000 made by the Consolidated City Railway Company, of Chicago, for its property. The Gary Interurban Railway is a new company operating only fifteen miles of trackage but has very valuable franchises and is now working on plans to connect all of the cities of the Calumet region with a network of rails.

SPRINGFIELD, MO.—Articles of association of the Jefferson Street Railway Company were filed for record with Recorder J. R. Whitlock.The capital stock of the company is $25,000, all of which has been subscribed and full paid. The share-holders are F. E. Miller, H. S. Jewell, H. B. McDaniel and Frank Curran each of whom hold twenty-five shares of stock. They also constitute the board of directors for the first year.

OAKLAND, CAL.—The wharves and waterfront committee of the city council, has recommended the passage of an ordinance, granting the San Francisco, Oakland and San Jose Railway, a franchise for 1,000 feet of wharfage space on the western water front. This strip includes the existing Key Route pier for which a franchise was never granted. The railroad company will pay the city $75,000 rental during the fifty years term of the franchise. A.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company has purchased 80 feet of land adjoining its Commerce Street power plant and will erect an addition sufficient to provide 60,000 horsepower, making the total at that point 80,000. The new equipment will consist of steam turbines, and 20,000 horsepower will be supplied by Dec. 1. This is made necessary not only by the growth of the system but by the increase of power demanded by the new city cars, which will require twice as much power as the present ones. The new cars will be in use soon.

LIMA. OHIO.—At the annual meeting of the Western Ohio Electric held here recently, the system was re-financed, and it is said all the bonds were sold. The Western Ohio Railway Company leases its line to the Western Ohio Railroad Company, a newly organized corporation with a capital of $1,000,000. Certificates of the old company will be exchanged for certificates of the new. The action means the absorption of the old company by the new, the Fostoria-Fremont link being provided for by a $500,000 bond issue already subscribed. Cleveland capitalists will be in control of the new company and the same officials will have charge. The system extends from Fremont to Piqua, with a branch to Celina, O. H.

INDIANAPOLIS, IND.—The Ft. Wayne and Winona Traction Company, recently formed, has filed articles of incorporation with the secretary of state. The corporation is capitalized at $100,000, divided into shares of $10 each. The purpose of the company is to build, maintain and operate a line or system of street and interurban railways into, through and connecting Ft. Wayne, Arcola, Coesse, Columbia City, Larwill, Pierceton, Wooster, Wiona and Warsaw, in Allen, Whitley and Koscuisko counties; also to produce and distribute electricity for light, heat and power purposes. The company's principal office and place of business will be in Ft. Wayne, Ind. J. A. Barry, Edward G. Hoffman, R. A. Barry, E. W. Cook and G. M. Lesslie are the directors. It is promised that work on the line will be begun soon. The line will be forty miles in length and will pass through one of the richest farming territories and connect numerous prosperous towns and cities. S.

GREENVILLE, S. C.—The Southern Railway has made definite announcement that it will put on gas-electric motor cars for passenger service in the Greenville district as soon as these cars can be turned out by the shops. The company announced some weeks ago that the use of the gas-electric cars was contemplated in some of the more crowded and congested sections, and the above announcement is in pursuance of the policy then referred to. The General Electric Company has agreed to return to the Southern a motor car experimented with some time ago, and this will be utilized until the new cars ordered shall have been completed. Two gas-electric cars are being built by the General Electric Company, and a gasoline car is being constructed by the McKeen Motor Car Company, of Omaha, Neb., for the same territory. The use of these cars will probably be the beginning of the general adoption of this service for short trips, and to relieve congested conditions whenever these may arise, upon short notice. L.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

DICKINSON, N. D.—The Independent Telephone Company is erecting a new building and rearranging its entire system of wires. C.

SAN JOSE, CAL.—The Orchards Rural Telephone Company has been granted permission to erect a telephone line on Las Animas, Murray and Cohansey avenues. A.

SEMINARY, MISS.—The People's Telephone Company has sold to the Cumberland Telephone Company its holdings at this place. The Cumberland company has been granted a franchise for fifty years.

CHARLESTON, MISS.—The Cumberland Telephone and Telegraph Company is making extensive improvements on its lines and plants in Charleston, installing a large number of new telephones and putting in additional cables.

TLAXIACO, STATE OF CAXACA, MEX.—The district of Tlaxiaco has just completed 315 miles of telephone lines in this district. The formal inauguration of the systems will take place at the centennial of Mexico's independence in September. D.

NEW CASTLE, IND.—The directors of the New Castle Independent Telephone Company are preparing to expend $65,000 in the improvement and rehabilitating the plant in this city. The Central Union Telephone Company will also expend about $15,000 in improving its system in this place. S.

LOS ANGELES, CAL.—Neither the Sunset nor the Home Telephone Companies will take new subscribers until the bankers who are carrying the bonds of the companies are satisfied with the rates fixed and furnish money for additional improvements. The Sunset Company refuses to make any extensions or improvements that are not obligatory. A.

RENO, NEV.—Manager Brown, of the Postal Telegraph Company's Reno office, announces that the work of building the line east across Nevada to Salt Lake City will commence in a short time. The right of way has been secured and the material is being assembled. When this line is completed, the Postal will have a direct line across the Continent, A.

AUSTIN, TEX.—The Texas Telegraph and Telephone Company has under consideration large extensions and improvements at Llano. The company elected the following officers at its recent meeting here: President, C. C. Gibbs of San Antonio; vice-president, William R. Hamby, Austin; secretary, George W. Polk, San Antonio; superintendent, R. F. Henry; treasurer, C. C. Gibbs. D.

FT. WAYNE, IND.—The Home Telephone Company has just completed a new line to Auburn and installed a new central energy equipment of the common battery type. The company is building

a new line between Ft. Wayne and Coranna and will next enter upon the work of constructing farm lines out of Ft. Wayne for a number of miles along the turnpikes. The company has installed thirty-two private exchanges in business houses during the past year. S.

HOUSTON, TEX.—Frank E. Ebersole, an electrical engineer of Omaha, has begun to fulfill a contract for the installation of the Houston Home Telephone Company, which will be operated in Houston and surrounding territory as a rival of the Southwestern Telephone Company. The new exchange will cost $1,200,000, and will be operated automatically, doing away with the necessity for central exchanges. It is the intention of the promoters to extend to Galveston.

HAMLIN, TEX.—A group of citizens of Hamlin has applied to the city council for franchise for a local and long distance telephone system here. The petitioners agree to allow the city to govern the rates with a minimum basis rate and to have option to purchase and own the system after three years under certain terms and conditions. The system will operate in competition with the Southwestern Telegraph and Telephone Company, which has a system here. D.

ELECTRICAL SECURITIES.

Although depressing influences were brought to bear on the market, there was on the whole a very slight lowering of the value of securities during the past week. In the total of 173 stocks which were dealt in, only fifty-seven show any lowering, while ninety-six show an advance in price. The remaining twenty-seven are unchanged. A gratifying event of the week was the compromise reached by the packing interests and the railroads, due to the efforts of George W. Perkins of J. P. Morgan & Company. The packers acknowledge that the roads are entitled to appreciable increase in rates and with this compromise as a precedent it is believed that other large interests which contribute to traffic will reach similarly successful agreements with the carriers.

The Pittsfield Electric Company has petitioned the Massachusetts Gas Commission for right to increase its stock from $225,000 to $450,000.

The West End Street Railway Company has petitioned the Massachusetts Railroad Commission for authority to issue $850,000 bonds for reduction of debt to lessee, Boston Elevated.

Directors of the Nashville Railway and Light Company have increased the annual dividend to 3 per cent, payable quarterly.

The New York Stock Exchange has admitted to its list $13,890,000 California Gas and Electric Corporation unifying and refunding mortgage five per cent thirty-year bonds, due 1937.

The Commonwealth-Edison's new bond issue will be little in excess of the $5,335,000 Chicago-Edison 5s to be retired. It has outstanding $19,500,000 first mortgage 5s and will have but one class of mortgage debt. Earnings are increasing satisfactorily and this year's special requirements were provided for by the sale of $3,000,000 new stock. The company's largest project in hand is the new station on the north branch of the river. All the members of the syndicate that has underwritten the new bond issue, except the Continental National, have been interested in previous financing by the company, including its first $10,000,000 bond issue. Eight local banks and bond firms are included.

May gross earnings of the Kings County Electric Light and Power Company increased $42,424, or 14.25 per cent over the same month last year. These were distributed as follows: $22.851 or 15.60 per cent increase in operating expenses; $450 or 1.34 per cent in depreciation and $11,757 or 23.17 per cent in fixed charges including interest on unfunded debt. The increase in bonds by issuance of $2,500,000 six per cent twelve year debentures adds $12,500 a month to fixed charges so that the increase in May fixed charges was slightly offset by a decrease in the amount of unfunded debt with consequent increase in unfunded debt interest charges. While earnings for May were only at the rate of 8.4 per cent a year, the five months ending May 31 show returns at the rate of 10.15 per cent a year. Lost year 8.41 per cent was earned on the $10,000,000 stock outstanding.

DIVIDENDS.

American Power and Light Company; the regular quarterly dividend of one and one-half per cent on the preferred stock, payable July 1 to stock of record June 27.

American Telephone and Telegraph Company; regular quarterly dividend of $2 a share, payable July 15 to stock of record June 30.

Bell Telephone Company of Canada; regular quraterly dividend of two per cent, payable July 15 to stock of record June 24.

Carolina Power and Light Company; preferred quarterly dividend of one and one-half per cent, payable July 1.

Central and South American Telegraph Company; quarterly dividend of one and one-half per cent, payable July 8.

Chicago City & Connecting Railways Company; two and one-fourth per cent on the preferred and one per cent on the common stocks, payable to stock of record June 21.

Chicago City Railway Company, regular quarterly dividend of two and one-half per cent, payable June 30 to stock of record June 21.

Cincinnati & Hamilton Traction Company; quarterly preferred dividend of one and one-fourth per cent, and common dividend of five-eights of one per cent, both payable July 1.

Cleveland Railway Company; quarterly dividend of one and one-half per cent, payable July 1.

Columbus Light, Heat and Power Company; common dividend of two per cent and preferred dividend of one and one-half per cent, payable July 1.

Columbus Railway and Light Company; quarterly dividend of three-quarters of one per cent, payable July 1.

Consolidated Traction Company of New Jersey; regular semi-annual of two per cent, payable July 15 as registered July 15.

Demorara Electric Company; quarterly dividend of one per cent, payable July 2.

Edison Electric Illuminating Company of Boston; quarterly dividend of three per cent, placing stock on regular twelve per cent basis, payable July 15.

Electrical Utilities Corporation; semi-annual preferred stock dividend No. 1 of two and one-half per cent, payable July 1 to stock of record June 27.

Gary & Interurban Railway Company; an initial dividend of one per cent, payable July 10.

Halifax Electric Tramways; quarterly dividend of one and three-quarters per cent, payable July 2.

Kansas Gas and Electric Company; quarterly dividend of one and one-quarter per cent, payable July 1.

Little Rock Railway and Electric Company; preferred dividend of three per cent, payable June 30.

Manchester Traction, Light and Power Company; $2, payable July 15.

Mexican Telegraph Company; quarterly dividend of two and one-half per cent, payable July 15.

Massachusetts Lighting Companies; quarterly dividend of one and three-quarters per cent, payable July 15.

Northwestern Elevated Railroad Company; quarterly dividend of one per cent, payable July 18.

Pacific Coast Power Company; $2.50 per share, payable July 16.

Public Service Corporation of New Jersey; quarterly dividend of one and one-quarter per cent, payable June 30.

Tri-City Railway and Light Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable July 1 to stock of record June 22.

Westinghouse Electric and Manufacturing Company; regular quarterly dividend of one and three-quarters per cent on preferred stock, payable July 15.

NEW YORK.

	June 27.	June 20.
Allis-Chalmers common	8¾	8½
Allis-Chalmers preferred	31	30½
Amalgamated Copper	64⅛	65
American Tel. & Cable	*80	*80
American Tel. & Tel.	136	136⅜
Brooklyn Rapid Transit	78½	78⅝
General Electric	144	145½
Interborough-Metropolitan common	18¾	18¾
Interborough-Metropolitan preferred	52	50⅞
Kings County Electric	124	124
Mackay Companies (Postal Telegraph and Cables) common	88	88
Mackay Companies (Postal Telegraph and Cables) preferred	73	74
Manhattan Elevated	126	130
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
U. S. Steel common	77⅝	78½
U. S. Steel preferred	116¼	115⅝
Western Union	64¼	64
Westinghouse common	63	61
Westinghouse preferred	125	*110

*Last price quoted.

BOSTON.

	June 27.	June 20.
American Tel. & Tel.	136	136⅝
Edison Elec. Illuminating	248	249
General Electric	144	145½
Massachusetts Electric common	16	16
Massachusetts Electric preferred	80	80
New England Telephone	132	133
Western Tel. & Tel. common	15	16
Western Tel. & Tel. preferred	84	80

PHILADELPHIA.

	June 27.	June 20.
American Railways	44	43¾
Electric Company of America	11⅝	11⅝
Electric Storage Battery common	55	54½
Electric Storage Battery preferred	55	54½
Philadelphia Electric	14⅞	14¾
Philadelphia Rapid Transit	19¾	20⅝
Philadelphia Traction	84¼	84½
Union Traction	47	47¼

CHICAGO.

	June 27.	June 20.
Chicago Railways, Series 1	70	*50
Chicago Railways, Series 2	19	*16
Chicago Subway	2¼	2¼
Chicago Telephone	120	97½
Commonwealth Edison	114	115
Metropolitan Elevated common	24	22½
Metropolitan Elevated preferred	69½	65½
National Carbon common	116½	114¼
National Carbon preferred	118	118

*Last price quoted.

PERSONAL MENTION.

C. T. ANDERSON, has been appointed manager of the Chicago office, 1616 Fisher Building, of the C. W. Hunt Company, New York, builders of coal handling, conveying and hoisting machinery.

SAMUEL D. GLOSS, formerly with the Simplex Electrical Company, has been appointed sales manager of the Atlantic Insulated Wire and Cable Company to succeed the late George F. Porter.

GEORGE H. WALBRIDGE, formerly of Colorado Springs, Col., has been elected president of the Central Colorado Power Company to succeed J. R. McKee. The office of general manager, from which Mr. Walbridge resigned, will be filled by F. C. Walcott of the banking and brokerage firm of Wm. P. Bonbright & Company of New York, London and Colorado Springs.

W. B. FOSHAY has been transferred to the Columbia Power and Light Company, of Walla Walla, Wash., from Wichita, Kans., where he has been manager and assistant secretary of the Kansas Gas and Electric Company. Mr. Foshay was formerly with the United Gas Improvement Company at Tarrytown, N. Y., and later held positions at Hutchinson, Kans., and Ft. Dodge, Iowa. At the latter place he rebuilt the gas and electric plant and distribution system. While at Wichita, Mr. Foshay installed the "Watch Wichita Win" sign, which was instrumental in largely increasing the business there.

EDWIN RUTHVEN WEEKS, of Kansas City, Mo., one of the most active workers in the early days of the National Electric Light Association, has called our attention to a discrepancy which appeared in the tabulation giving the dates and places and names of the presidents of the conventions which have been held by the National Electric Light Association. Mr. Weeks points out that at the Detroit convention, August 31 to September 2, 1886, while J. F. Morrison was president of the association he was not present at any of the convention sessions, and they were all conducted with Vice-President Weeks in the chair. Mr. Weeks was president of the Kansas City convention of February 11 to 14, 1890, and Marsden J. Perry was elected president at the closing session of that convention.

JOHN T. KELLY, of Pittsfield, Mass., was recently awarded the John Scott medal on the recommendation of the Franklin Institute of Philadelphia. The medal was given in recognition of inventions and improvements in piano players. Mr. Kelly has since an early age, been interested in electrical subjects and in science of all kinds. At the age of nineteen he was graduated from the Stevens institute, having done special work in chemistry and in electrical measurements. After graduation he was employed as a chemist in the laboratory of Thomas A. Edison, going from there into the electrical work of the Western Electric Company. A few years later he became assistant to Edward Weston, who was at that time chief electrician of the United States Electric Lighting Company. When Mr. Weston resigned from the United States Company, Mr. Kelley was appointed to take his place, and remained in charge of the electrical work until the company was absorbed by the Westinghouse Electric and Manufacturing Company. He then became electrician of the Newark shops of the combined companies. Resigning from this position Mr. Kelly became connected with the Stanley Laboratory Company and was afterwards made consulting engineer of the Stanley Electric Manufacturing Company of Pittsfield, Mass., which position he still retains. He has always been active in electrical inventions, and was the originator of a number of electrical measuring instruments.

OBITUARY.

HENRY GREENFIELD, president of the Highland Telephone Company and at one time a resident of Greenpoint, N. Y., died last week at Central Valley, N. Y., of blood poisoning caused by a cut from a rusty nail. Mr. Greenfield, who was sixty-seven years of age, was born in Germany and came to this country in his twentieth year.

GEORGE N. EASTMAN died on June 14 at Riverside, Calif., Mr. Eastman was born in Canada, but moved to Michigan at an early age and attended the Michigan Agricultural College. He began work with the Commonwealth Edison Company of Chicago in March, 1898, but about five years ago his health broke down and after sojourning in Europe, he went to California where he has since resided. Mr. Eastman was a member of the Western Society of Engineers and the American Institute of Electrical Engineers, and has written a number of valuable papers on technical subjects.

WILLIAM HENRY BROWN, of Philadelphia, formerly chief engineer of the Pennsylvania Railroad, died suddenly a short time ago in Belfast, Ireland, from heart failure. Mr. Brown was born in Lancaster County, Pa., Feb. 29, 1836. His connection with the Pennsylvania Railroad dated back to the Civil War, when he served under Colonel Thomas A. Scott, who had charge of the military railroad forces. He also served as engineer of the United States military railroads in northern Virginia. In the sixties, Mr. Brown helped complete the Pan Handle Railroad and after occupying various positions with the Pennsylvania Railroad Company, was made chief engineer on June 1, 1881. He was retired February 28, 1906, on a pension.

LEGAL NOTES.

TELEGRAPH AND TELEPHONE COMPANIES INCLUDED IN COMMISSION LAW.—The supreme court of Nebraska holds, Western Union Telegraph Company vs. State, 124 N. W. R., 937, that chapter ninety of the laws of 1907, commonly known as the "State Railway Commission Law," an act creating such commission, providing a method of fixing rates, etc., in so far as its provisions relate to the prevention of abuses, extortions, and unjust discriminations, is applicable to common carriers of news and intelligence, such as telegraph and telephone companies, as well as to common carriers of goods and passengers.

PECULIAR RIGHTS AND DUTIES BETWEEN ELECTRICAL COMPANIES.—The peculiar nature of the business that telephone, telegraph, light and power companies are engaged in, the liability of their wires to interfere with each other, and through the medium of each other's wires, to inflict great damage, not only to the property of each other, but to endanger the lives of their employes and of their patrons, the public, the appellate court of Indiana says, in Beaming vs. South Bend Electric Company. 90 N. E. R., 786, create rights, duties and obligations of such companies with reference to each other peculiar to the business. The mutual interest of the companies concerned and the safety and protection of the public require that the employes of each company shall be accorded the right to use the other's poles, and handle their wires, when necessary to locate and remedy defects arising from their wires crossing each other, and these considerations would seem to require each company to exercise reasonable care to protect the employes of the other so engaged.

NEW INCORPORATIONS.

TOLEDO, OHIO.—Among new incorporations was the S. L. Electric Company, with an authorized capital stock of $5,000. The concern has secured business quarters at 243 Michigan Street, and will do a general electrical engineering business. H.

COMO, N. J.—The Como Electrical Company has been incorporated to manufacture electrical and mechanical devices, with a capital of $50,000. The incorporators are: W. W. Rowan, Asbury Park; T. Hickley, Spring Lake; W. E. Anderson, Englishtown.

ALBANY, N. Y.—The International Electric Protection Company of New York was incorporated to manufacture electric signaling systems. The capital is $5,000,000 and the directors are Frank Rhodes, S. H. Freund, A. M. Trueb, J. J. Quinlan, New York; Roberts Walker, Scarsdale; H. M. Sloan, Douglaston, L. I.; F. A. Smith East Orange, N. J.

NEW YORK, N. Y.—Articles of incorporation have been taken out with the New York secretary of state by the Multiple Unit Electric Company of New York city. The concern will manufacture and deal in electric furnaces and cooking apparatus. The capital stock is $100,000 and the directors are Moses M. Riglander and Jacob W. Riglander of No. 49 Maiden Lane, New York city, and Milton M. Kohn, of No. 253 Broadway, New York city. T.

PROPOSALS.

TACOMA, WASH.—Nicholas Lawson, commissioner of light and water, will receive bids up to 2 p. m., July 5, for the construction of a stone, concrete and brick substation at South Twenty-fifth and C. Streets. The cost is to be about $95,200. C.

POWER PLANT, INDIANOLA, IA.—This city will receive bids until July 11, for one 150-kilowatt direct-current, engine-type generator, and one 16 by 36 inch Corliss engine, both machines to be delivered and erected by the contractors. C. C. Litzenberg is city electrician.

POST OFFICE, LEWISTON, IDA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until July 27 for the construction, complete (including plumbing, gas-piping, heating apparatus, electric conduits and wiring), or the United States post-office at Lewiston, Ida., in accordance with drawings and specifications, copies of which may be obtained from custodian of site at Lewiston, Ida., or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies.

Date of Opening.	Material.	Quantity.	Places of Delivery.	Schedule No.
July 12	Apparatus, telegraph, wireless		Brooklyn, N.Y.	2647
	Cable, electrical	5,963 feet	Philadelphia, Pa.	2658
	Generator, motor	1	Washington, D. C.	2661
	Holders, fuse	Miscellaneous	Brooklyn, N. Y.	2658
July 26	Carbons, searchlight	Miscellaneous	Mare Island, Cal.	2653
	Jars, Leyden	360	Mare Island, Cal.	2653
	Lamps, navigators', electrical	6	Mare Island, Cal.	2653
	Micanite, plate	190 pounds	Mare Island, Cal.	2653
	Tape, insulating, rubber	300 pounds	Mare Island, Cal.	2653
	Tape, insulating, cotton	1,850 pounds	Mare Island, Cal.	2653
	Tubes, conduit, stuffing	Miscellaneous	Mare Island, Cal.	2653
	Wire, platinum	4¼ ounces	Mare Island, Cal.	2653
	Wire, rat-tail	Miscellaneous	Mare Island, Cal.	2653

INDUSTRIAL ITEMS.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., has distributed a loose leaf bulletin containing prices on Delta-Star specialties, as well as a good deal of valuable information and formula.

THE DETROIT FUSE AND MANUFACTURING COMPANY has opened a Chicago agency with the Continental Electric Company at 221 South Clinton street, where a complete stock of Arcless B fuses and Detroit switches will be kept.

THE AMERICAN INSULATED WIRE AND CABLE COMPANY, Chicago, Ill., through N. T. Brenner, president, states that it is possible that it will enter the rubber-covered wire field. The company contemplates increasing its capital to carry out the above venture.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., is mailing to the trade an attractive loose-leaf booklet on Pittsburgh transformers. Distributing transformers, mill-type, oil-insulated water-cooled transformers and tungsten sign-lighting low-voltage transformers are described and in each case photographs of both the complete transformer and views with cover removed are shown. An interesting view shown is that of a carload shipment of furnace transformers for the United States Steel Corporation.

THE AMERICAN ARC LAMP COMPANY, Kalamazoo, Mich., manufacturer of miniature inclosed arc lamps, is distributing Bulletin No. 43, devoted particularly to lamps suitable for shop lighting. The bulletin contains descriptions of the American standard direct-current multiple shop lamp with eighteen-inch steel porcelain enameled shade; standard outdoor lamp with clear outer globe and standard and miniature lamps for store and office use. A feature of these lamps is the patented cover, which may readily be opened, permitting access to the interior from every direction.

THE CUTLER-HAMMER CLUTCH COMPANY, Milwaukee, Wis., has issued a folder calling attention to the work that can be done by "One Man and a Magnet." Six illustrations which appear in the folder show how one man (the crane operator) and a lifting magnet can perform various tasks more quickly and economically than is possible by any other means. These magnets are used for unloading pig iron, handling scrap, castings and doing other work involving lifting. A large cross-section drawing of the magnet is given and each part of the apparatus and each feature of construction described.

THE EXCELLO ARC LAMP COMPANY has issued a valuable publication on flaming arc illumination. At first is given a short review of how the flaming arc lamp came to be developed and of the many situations for which it was found particularly suitable, such as advertising street lighting, mill and foundry lighting, etc. The elementary principles of the flaming arc are explained and how these are carried out in Excello lamps is clearly described. After giving the advantages of these lamps there is a discussion of their light distribution and a comparison of their ultimate economy as compared with the ordinary enclosed arcs.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has ready for distribution Catalog No. 8 and Catalog H. The former is an attractive bound book of 170 pages and contains a complete line of perfected appliances used in the construction, maintenance and operation of electric railways, mine-haulage systems and transmission lines. All of the appliances listed are fully described and complete engineering data given. Catalog H is devoted to Ohio radiator valves, union elbows, globe angle check valves, pressure regulating valves and steam specialties. Both publications contains numerous views and diagrams of the apparatus listed.

THE HEMMING MANUFACTURING COMPANY, New York, N. Y., has recently issued a booklet descriptive of Hemming insulation. The booklet not only explains the nature of this specially-prepared fireproof and waterproof insulation, but also gives a number of illustrations showing the forms into which insulating material is molded. "Hemit," which is the name given to this material, is very hard, though not brittle. It may be used in either high-tension or low-tension work and a partial list of the uses to which it may be put is contained in the booklet. The company invites proposals and offers to design and send free samples of any special insulating parts.

THE GARWOOD ELECTRIC COMPANY, New York, N. Y., has appointed the Varney Electrical Supply Company, 235 South Meridian Street, Indianapolis, Ind., its agent in the territory covering that portion of Indiana south of a line drawn east and west through Fort Wayne, except Bedford and within a radius of ten miles of Bedford; that portion of Kentucky bounded on the east by a line drawn north and south through Frankfort and including Frankfort and on the west by a line drawn north and south through Henderson and including Henderson. The same company has also appointed the Electrical Manufacturers Sales Company, of Denver, Colo., its agent in the territory covered by Colorado, Wyoming, Utah, New Mexico and eastern half of Idaho.

THE WESTERN ELECTRIC COMPANY has just issued its bulletin 5533, describing Hawthorn series-incandescent lighting system with Sunbeam Mazda lamps. This bulletin gives details of and operating data for lamps and constant current transformers suitable for use on series lighting circuits. It lists standard switchboard panels for controlling lighting circuits, and pole brackets, hoods and reflectors for use in the construction of these circuits. This bulletin also describes and lists the standard porcelain series socket with automatic cut-out, which becomes effective in case of any particular lamp being damaged. A new device brought to notice in this bulletin is the safety automatic cut-out, a device for protecting series street lighting circuits in case any portion becomes ruptured. This bulletin as a whole gives valuable information and sufficient data for use in laying out series circuits for lighting suburban or residential districts.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., reports unusually good business both for export and domestic shipment. Among the former may be mentioned a carload of electrical machinery and engines to Japan, a generator and other equipment to Venezuela. Among domestic shipments may be mentioned two carloads of induction motors to the Cleveland Worsted Mills, Cleveland, Ohio, a carload of motors and generators to Wright & Sweeney Company, Tacoma, Wash., a carload of motors to Hart-Parr Company, Charles City, Iowa, a carload of motors to Hicks Locomotive and Car Works, Chicago Heights, Ill., a carload of National motors to the Pacific Cooperage Company, San Francisco, Calif., a General Electric alternator to the Helena Gas Company, Helena, Ark., a General Electric generator and engine to W. H. Lagb, Houghton, Mich., a Westinghouse generator to the Winters and Prophet Canning Company, Mt. Morris, N. Y., and a General Electric alternator to the Tiffin Electric Company, Tiffin, Ohio.

THE PARAGON SELLERS COMPANY, of 56 Fifth avenue, Chicago, Ill., announces that it has taken over the business of the Durant Electric Supplies Company and of F. W. Pardee of the same address. The personnel of the new company is as follows: President, E. M. Platt; vice president, F. W. Pardee; secretary, E. E. Dewey; treasurer, R. E. Macduff. The personnel of the new company is practically the same as that of the old and the business will be carried on along the same lines as the old business of the Durant Electric Supplies Company and F. W. Pardee. The Paragon Sellers Company is the exclusive producer of "Ironite" duplex drop wire used by telephone companies and of the "Paragon" specialties including the "Paragon" ground cone, "Paragon" self-tying knob, "Paragon" messenger support, and "Paragon" battery box. The Paragon Sellers Company claims of the ground cone that its total cost installed is less than the cost of ordinary ground plates, junk copper, etc. Literature covering any of the above specialties will be sent on request.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued Bulletin 4739, describing the General Electric Mazda incandescent lamp which has an improved tungsten filament and gives the high efficiency of one to one and one-fourth watts per candle. The bulletin describes this lamp in great detail, and illustrates the various sizes of this type of lamp for use on multiple circuits. It contains tables showing cost of operation and life, effect of voltage variation on candlepower and watts, relative costs of lighting with various lamps for equal illumination, etc., etc. It also devotes considerable space to the reflectors necessary to give the best results. In Bulletin 4744, just issued by the General Electric Company, is described a device designed for the purpose of making the periodical calibration of service wattmeters most efficiently and with the least possible annoyance to the customer. The device is known as a meter testing rheostat, and is so arranged as to give various loads with little trouble to the person testing.

DATES AHEAD.

American Society for Testing Materials. Annual meeting, Atlantic City, N. J., June 28-July 2.

Canadian Electrical Association. Annual convention, Lake Rosseau, Ontario, Canada, July 6, 7 and 8.

American Society of Heating and Ventilating Engineers. Semi-annual meeting, St. Louis, Mo., June 30-July 1.

Southern Textile Association. Convention, Augusta, Ga., July 2.

National Electric Contractors' Association. Annual convention, Atlantic City, N, J., July 20, 21 and 22.

Ohio Electric Light Association. Annual convention, Cedar Point, Ohio, July 26, 27 and 28.

Michigan Electrical Association. Annual convention, Port Huron, Mich., August 16, 17 and 18.

League of American Municipalities. Annual convention, St. Paul, Minn., August 23-26.

Pacific Coast Electrical Exposition. San Francisco, Cal., August 20 to August 27, 1910.

New England Section, National Electric Light Association. Fall convention, Pleasant Point, New London, Conn., September 13 and 14.

Colorado Electric Light, Power and Railway Association. Next convention, Glenwood Springs, Col., September 21, 22 and 23.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 10-14.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 21, 1910.

961,754. MUSIC-ROLL PRODUCER FOR SELF-PLAYING PIANOS. Donald M. Cloak, Dover, Del. Filed Dec. 22, 1909. A piano keyboard has keys controlling an electirc circuit for operating an electromagnetically actuated perforation-spacing device.

961,776. ELECTRICAL MEANS FOR OPERATING CLOCK-PENDULUMS. John F. Holmes, Waterbury, Conn. Filed July 27, 1909. An arm connected to and carried by the pendulum bears a contact pin; a block of insulating material, having an elliptical groove, guides the pin of the arm; a metallic plate is set in the groove to contact with the pin; and a magnet has an arm bearing an armature with attached means for engaging and throwing the pendulum rod with each complete forward and backward swing.

961,786. TROLLEY-WHEEL GUARD. Henry L. Miller, St. Louis, Mo. Filed Sept. 21, 1909. A pair of plates disposed in parallel upon the opposite sides of the harp are concentrically and pivotally mounted with the pulley disposed in the harp; upwardly extended projections are disposed in parallel from the plates projected over the edges of the pulley; projections are disposed on the plates upon the opposite sides of the upwardly projected projections mounted in parallel and engaged about the edges of the pulley, all of the projections being diverged upwardly and outwardly from the pulley; and means are provided for tensionally holding the upwardly extended projections in normal position.

961,805. ELECTROMAGNET. Campbell Scott, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed July 30, 1906. Covered wire is wound spirally and in superimposed layers on a paper spool, and a moisture-proof, strong, adhesive insulation impregnates the paper spool and filling, substantially, all the interstices between the wire and the spool, and between the successive convolutions and layers of the wire.

961,815. TELEPHONE RELAY OR REPEATER. Louis W. Southgate, Worcester, Mass. Filed March 3, 1902. A telephone relay or repeater comprises a coil or electromagnet and a microphone, and an unattached armature responsive to magnetic variation arranged in the field of the coil or electromagnet for actuating the microphone.

961,826. ELECTRICALLY-PROTECTED PLATE AND LINING FOR VAULTS, SAFES, ETC. John P. Williams, New York, N. Y., assignor to Electric Bank Protection Company. Filed March 18, 1909. Alarm circuits are thermostatically controlled.

961,827. ELECTRIC CABLE FOR BURGLAR-ALARM SYSTEMS. John P. Williams, New York, N. Y., assignor to Electric Bank Protection Company. Filed March 18, 1909. An electric cable for alarm systems comprises a thermostatic core portion constituting the thermostatic division of the cable and embodying the circuit conductors which are thermostatically operatable to cause the sounding of the alarm by the action of heat and a main outer portion constituting a division of the cable supplementary to the thermostatic portion and exterior thereof and surrounding the same and embodying the circuit conductors which are operatable to cause the sounding of the alarm by severance of the conductors, the conductors of the thermostatic core portion and the conductors of the supplementary outer portion being relatively arranged in circuits having open and closed conditions, whereby when the conductors of both the thermostatic portion and the outer portion of the cable are connected in alarm circuits the alarm will be sounded either by the cutting of the conductors of the main outer division or the action of heat or flame on the thermostatic division.

961,853. FIRE-ALARM SYSTEM. James H. Garratt and William J. McGivern, Rochester, N. Y., assignors to J. Geo. Kaelber, Rochester, N. Y. Filed Feb. 2, 1905. An electric signaling system.

961,855. DETECTORIUM. Hugo Grensback, New York, N. Y. Filed Feb. 5, 1910. A wireless telegraph and telephone tuning coil includes a movable contact element of such material as to form a detector.

961,884. ATTACHMENT FOR COMBINATION DIALS ON SAFES, VAULTS, ETC. Moses Mosler, New York, N. Y. Filed May 17, 1909. Includes a lamp and battery.

961,887. MEANS FOR ILLUMINATING CAR-STEPS. William H. McAloney, Denver, Colo., assignor to The Automatic Signal Light Company, Colorado Springs, Colo. Filed Aug. 23, 1909. The car has a recess formed in the wall thereof above the entrance, a reflector located in the recess and curved upwardly, in order to throw light rays downwardly upon the steps below the entrance, and an illuminating device located within the recess and below the reflector.

961,891. RECHARGEABLE ELECTRIC FUSE. Agostine J. Orelli, Longbeach, Cal. Filed Feb. 21, 1910. A rechargeable electric fuse comprises a shell of insulating material, provided with a metallic ferrule at each end, a radially slotted disk resting on the ferrule at each end of the shell, a fuse strip provided with longitudinally extending terminal strips at each end (these strips extending within the slots of the disks and being bent over at the ends), and terminal caps screwing on the end ferrules and bearing on the bent-over portions of the terminal strips of the fuse strip to make contact therewith, the bent-over portions of the terminal strips being bowed and being of elastic material to provide spring contact.

961,902. CIRCUIT-INTERRUPTER FOR ELECTRIC SPARKING DEVICES. James E. Seeley, Los Angeles, Cal., assignor to High Frequency Ignition Coil Company, Los Angeles, Cal. Filed July 8, 1909. A circuit-controlling device comprises an operating shaft, movable contact means mounted to rotate with the shaft, a movable actuating member mounted to rotate with the shaft, a member mounted to rotate through a limited angle and having cam faces engaging with the contact means and with the actuating means to store energy in the actuating means during a portion of the rotation of this shaft and to utilize this energy in the operation of the contact means.

961,904. AUTOMATIC GAS CUT-OFF. John H. Skillcorn, Pittsburg, Pa. Filed Dec. 8, 1909. An electromagnetically operated valve is thermostatically controlled.

961,912. METHOD OF HEATING CARBON. Frank J. Tone, Niagara Falls, N. Y. Filed Feb. 4, 1907. The method of purifying graphite consists in forming on electric arc within a mass of impure graphite and between electrodes, preventing any substantial contact between the carbon and one of the electrodes, and transmitting the heat of the arc to the graphite mass sufficiently to votalize the impurities and allowing the volatilized products to escape from the graphite.

961,914. WIRELESS LIGHTING SYSTEM. Edward B. Tustin, Jr., Bloomsburg, Pa. Filed April 1, 1908. A circuit controller for a lighting circuit is wirelessly operated.

961,922. TIME-CONTROLLER FOR ELECTRIC TIME-LOCKS OR BURGLAR-ALARM SYSTEMS. John P. Williams and Hermann Huhn, New York, N. Y., assignors to Electric Bank Protection Company. Filed Sept. 4, 1909. A time-controller comprises a clockwork, a clockface insulated therefrom, a hand or indicator carried by the clockwork, a frame pivoted transversely upon the hand, a conductor contact carried at one end of the frame, an insulating contact carried at the other end of the frame, and means actuated by the movement of the hand for pivotally moving the frame.

961,937. ELECTRIC WATER-HEATER. William F. Cutler, San Francisco, Cal., assignor to Cutler National Electric Heater Company, San Francisco, Cal. Filed July 8, 1909. In combination with a heating chamber are a vertical series of inverted cup-shaped insulators therein, coils in the insulators, electric conductors leading to the coils, and means for admitting liquid into and out of the heating chamber.

961,945. METHOD OF MANUFACTURE OF BICARBONATE OF SODA. Robert Hugh Forsythe Finlay, Belfast, Ireland. Filed July 17, 1908. In the manufacture of bicarbonate of soda by the Solvay process, the mother liquor is subjected to electrolysis in the cathode chamber of a cell separated by one or more diaphragms from the anode chamber which is filled with sodium-chloride solution for the purpose of recovering the ammonia and obtaining hydrogen and chlorine.

961,951. CIRCUIT-CONTROLLER. Fred I. Getty, Jennings, La., assignor to Charles F. Gillmann, New York, N. Y. Filed Jan. 20, 1910. Includes a clock-controlled contact device.

961,952. ELECTRIC CLOCK. Fred I. Getty, Jennings, La., assignor to Charles F. Gillmann, New York, N. Y. Filed Jan. 20, 1910. A weight arm for operating the clock train is electromagnetically reset.

961,962. PROTECTIVE DEVICE. Jesse D. Hoffman, Duke, Okla., assignor of one-half to Nancy L. Burrow, Duke, Okla. Filed Sept. 21, 1909. A grounding device for telephone circuits, etc.

961,973. ADJUSTABLE SHADE FOR ELECTRIC LIGHTS. David D. Lockwood, Bridgeport, Conn. Filed June 5, 1909. A shade for an incandescent light bulb.

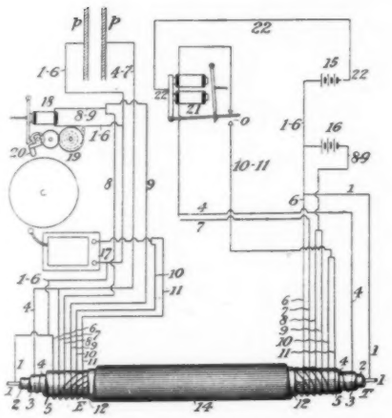
961,978. ELECTRICAL CONDENSER. Ray H. Manson, Elyria, Ohio, assignor to The Dean Electric Company, Elyria, Ohio. Filed May 29, 1907. A condenser terminal consists of a strip of metal split part way down from one of its ends and each split portion bent in opposite directions to positions at angles

with the unsplit end, one of the split parts serving as a terminal for an electric circuit, the other split part serving as a terminal for the condenser, and mechanical means are associated with the unsplit end attaching it to the insulated cover of the condenser.

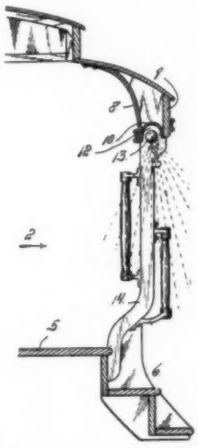
961,984. APPARATUS FOR BONDING RAILS. William A. Neff, Cleveland, Ohio, assignor to The Electric Railway Improvement Company, Cleveland, Ohio. Filed June 22, 1908. In combination with a truck movable along a track are a transversely movable supporting member borne thereby, a second member pivotally secured to the first member about a vertical axis, and two electrode members pivotally secured at their upper ends about independent horizontal axes to the second member.

962,014. METHOD OF ELECTRIC SIGNALING. Reginald A. Fessenden, Washington, D. C., assignor to The National Electric Signaling Company, Pittsburg, Pa. Filed Jan. 9, 1905. The method consists in causing a current to flow through a constricted conducting fluid path, producing a change in a portion of the fluid at a point outside of the constricted path and causing the changed portion to move into the constricted path and thereby vary the current flowing therethrough.

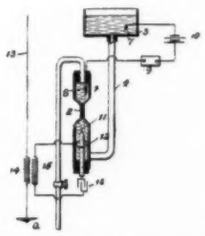
962,015. RECEIVER FOR ELECTRIC SIGNALING. Reginald A. Fessenden, Washington, D. C., assignor to The National Electric Signaling Company. Original application filed Jan. 9, 1905. Divided and this application filed Jan. 6, 1906. A receiver for



961,827.—ELECTRIC CABLE FOR BURGLAR-ALARM SYSTEM.



961,887.—MEANS FOR ILLUMINATING CAR STEPS.



962,014.—METHOD OF ELECTRIC SIGNALING.

electromagnetic waves has a constricted conducting fluid path, means for producing a bubble and means for causing the bubble to move into the constricted fluid path.

962,016. RECEIVER FOR ELECTROMAGNETIC WAVES. Reginald A. Fessenden, Washington, D. C. Filed March 16, 1906. A liquid barretter has two fine terminals, a large terminal and an electrolyte.

962,017. ELECTRICAL APPARATUS. Reginald A. Fessenden, Brant Rock, Mass. Filed April 18, 1906. Electrically actuated means for producing an indication comprise a movable indicating member and a coil in operative relation to the movable member, having high coefficient of magnetic inductance per unit of mass, i. e., a ratio of self inductance to mass of more than 100,000.

962,018. METHOD OF SIGNALING. Reginald A. Fessenden, Brant Rock, Mass. Original application filed Oct. 10, 1907. Divided and this application filed June 24, 1908. The method of signaling consists in maintaining a continuous flow of impulses at a receiving station, normally annulling their effect by received impulses sent from another station, and signaling by modifying the sent impulses and thus interrupting the normal annulment.

962,033. COMBINED BATTERY-RECEPTACLE AND BELL-SUPPORT. James L. Koerber, Houston, Tex. Filed Jan. 5, 1909. A metallic tongue and grip are carried by the receptacle walls, a bell support is carried by the receptacle, and a metallic tongue carried by the bell support is designed to contact with the tongue carried by the wall, when the support is secured to the receptacle.

962,040. APPARATUS FOR ELECTRICAL TREATMENT OF ORES. William B. McPherson, Los Angeles, Cal., assignor of one-half to Gail Borden, Los Angeles, Cal. Filed April 20, 1909. The apparatus comprises a central electrode therein, and an outer electrode (concentric with the central electrode) which is hollow and provided with means for passing heating medium therethrough.

962,055. ELECTRIC FIXTURE. George Frederick Rush, Chicago, Ill. Filed Sept. 15, 1909. A wall lamp fixture.

962,063. STRAIN-RELIEF FOR LAMP-SOCKETS. Frederick A. Swan, Cliftondale, Mass. Filed May 4, 1908. In combination with a shell is a body of insulating material within the shell, with terminals supported thereby, the body having integral within a strain-relief projection about which the conducting wire may be wrapped.

962,071. ELECTRICAL CONNECTION. Maurice J. Wohl, and Harry Hertzberg, New York, N. Y., assignors to Economy Electric Company, Brooklyn, N. Y. Filed Nov. 26, 1907. A lamp socket and tap.

962,076. ELECTRIC-LAMP SOCKET-COVER AND SHADE-HOLDER. George W. Cassidy, East Orange, N. J. Filed Feb. 16, 1910. A top is adapted to be secured to the fixture and to receive a lamp socket centrally therein, and a depending shell covering the socket is removably secured to the top, the joint being located so as to give access to the socket-holding devices.

962,082. PRINTING-TELEGRAPH. Theodore M. Foote, Allston, Mass. Filed July 23, 1908. A printing telegraph comprises three printing wheels arranged to produce printing impressions upon a traveling record strip in three different lines thereon, two of such printing wheels having co-incident axes, and the third printing wheel having its axis arranged parallel thereto, at a point in advance thereof in the direction of movement of the record strip, the two printing wheels containing respectively the letters of the alphabet and a full set of numerals, whereby the one is adapted for printing stock titles, and the other stock quotations, and the third printing wheel also containing a full set of numerals whereby it is also adapted for printing stock quotations; and electrically controlled selecting means determine which printing wheel is to be employed at any given time.

962,101. ALTERNATE-CURRENT COMMUTATOR-MOTOR. Rudolf Richter, Charlottenburg, Germany, assignor to Siemens-Schuckertwerke G. M. B. H., Berlin, Germany. Filed Jan. 15, 1907. The motor has an armature and a grooved stator, and auxiliary windings in series and in shunt to the armature to neutralize the reactance and transformer tensions in the short-circuited coils of the armature, the two auxiliary windings being disposed in different grooves of the stator, one of the auxiliary windings within the other.

962,106. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Coupler Company, New York, N. Y. Filed April 10, 1909. Includes a main generator and an auxiliary generator, a battery, etc.

962,109. TELEPHONE, FENCE, AND TELEGRAPH POLE. Henry M. Adams, Oxford, Nebr. Filed Nov. 1, 1909. A transversely positioned lifting bar is embedded within the base at the point of union of two cylindrical bores, the bar being provided with an upwardly extending annulus lying flush with the face of the upper bore.

962,113. AUTOMATIC GAS IGNITION AND CONTROL. Louis G. Bartlett, Somerville, Mass., assignor to Auto-Lighter & Equipment Company, Boston, Mass. Filed Sept. 24, 1909. An electrical ignition attachment for gas burners.

962,129. ELECTROMAGNETIC DEVICE. Walter A. Crowdus,

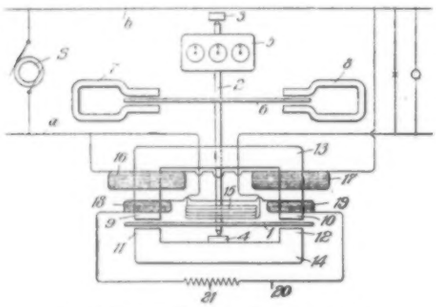
Chicago, Ill. Filed Feb. 1, 1909. Renewed Dec. 11, 1909. The device comprises an electric circuit, a circuit-breaker in the circuit, a movable magnet co-operating with the circuit-breaker, and a magnetc body supported to move through the magnetic field of the movable magnet and thereby actuate the magnet.

962,222. ELECTRICITY-METER. Dugald C. Jackson, Madison, Wis., assignor to Dugald C. Jackson and William B. Jackson, Madison, Wis. Filed Feb. 12, 1906. Renewed May 11, 1910. The meter comprises a movable element, a magnetic circuit for this element, windings co-operating with the magnetic circuit to produce torque for driving the movable element (variations in temperature tending to vary the speed of the movable element), a closed secondary circuit associated with the windings and magnetic circuit, and a heat-responsive element in the secondary circuit for changing the current flow therethrough in accordance with changes in temperature whereby the speed is maintained constant.

962,255. SPARKING APPARATUS. Albert F. Rockwell, Bristol, Conn., assignor to The New Departure Manufacturing Company, Bristol, Conn. Filed March 12, 1906. A sparking circuit comprises a plurality of stationary electrodes, a single electrical connection in communication with all of the electrodes, a plurality of rotatably mounted reciprocating pistons constituting co-operating electrodes for the first-named electrodes, and a removable sparking ring carried by each piston.

962,261. ELECTRICAL PIANO. Robert A. Rose and George C. Holbrook, Santa Rosa, Cal. Filed March 29, 1909. The hammers are electromagnetically actuated.

962,262. WAVE-DETECTOR FOR WIRELESS TELEGRAPHY. Wilhelm Schloemilch, Berlin, and Paul Fernand Pichon, Südende, near Berlin, Germany, assignors to Gesellschaft für Drahtlose Telegraphie M. B. H., Berlin, Germany. Filed April 14, 1906. A wave detector for wireless telegraphy consists of two contact bodies, one of which is formed of one of



962,222.—ELECTRICITY METER.

the naturally found manganese compounds containing moisture, and the other of a material which oxidizes with difficulty.

962,263. SECONDARY BATTERY. Hugo Paul Schreiber, London, England. Filed July 13, 1909. An electric storage battery comprises an external electrode in the form of a cylindrical leaden tube, a layer of active material inside the tube, a cylindrical porous division inside the active material, an internal electrode in the form of a cylindrical leaden tube inside the porous division, a layer of active material surrounding the inner leaden tube, a liquid electrolyte and passages through the layers of active material lined with the metal of the electrodes.

962,307. ELECTRIC TIME-SWITCH. Carey E. Bunker, Oregon, Mo. Filed Sept. 16, 1909. A switch-closing gear is revolubly mounted in the clock, etc.

962,314. JUMP-SPARK IGNITER-PLUG. Louis Bond Cherry, Aberdeen, S. D., assignor, by direct and mesne assignments, to The Ball Multi-Spark Plug Co., Aberdeen, S. D. Filed Jan. 17, 1910. An igniting device has opposing curved smooth electric-condenser-surface electrodes arranged one within the other and separated by an annular spark gap.

962,334. ALTERNATING-CURRENT MOTOR. Valère Alfred Fynn, London, England. Filed July 3, 1909. The motor comprises a stator provided with a plurality of windings, a laminated rotor provided with a permanently short-circuited winding and two commuted windings, the short-circuited winding extending over all the rotor laminations and each of the commuted windings extending over a part only of the rotor laminations.

962,335. ALTERNATING-CURRENT MOTOR. Valère Alfred Fynn, London, England. Filed July 9, 1909. The motor comprises a stator provided with a plurality of windings, a rotor provided with a permanently short-circuited winding and a commuted winding, the conductors of these two windings which lie adjacent to each other on one-half of the rotor laminations being displaced from each other by 360/n degrees on the other half.

962,336. ALTERNATING-CURRENT MOTOR. Valère Alfred Fynn, London, England. Filed July 9, 1909. The motor comprises a stator, a laminated rotor provided with a permanently short-circuited winding and a commuted winding, the short-circuited winding extending over all the rotor laminations and the commuted winding extending over a part only of the rotor laminations, and means disposed on the stator for producing a main flux through each of the rotor windings.

962,337. ALTERNATING-CURRENT MOTOR. Valère Alfred Fynn, London, England. Filed July 9, 1909. The motor comprises a stator, a plurality of windings on the stator, a rotor having two groups of laminations, a commuted winding disposed on each group of laminations, the commuted windings being interconnected at a plurality of points, and means for reversing the current through one of the stator windings.

962,365. TROLLEY. George A. Lefley, West View, Pa. Filed September 24, 1909. A spring and ratchet control for a trolley pole.

962,388. AUTOMATIC SWITCH. James M. Rhett, Beaufort, S. C., assignor of one-third to Niels Christensen, Beaufort, S. C. Filed October 3, 1907. A governor-controlled switch for a motor which has a flywheel.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired June 27, 1910:

500,132. ELECTRIC MOTOR AND DYNAMO-ELECTRIC MACHINE. Rudolph M. Hunter, Philadelphia, Pa.

500,135. ELECTRIC MOTOR. Charles S. Jones, Chicago, Ill.

500,144. BRUSH HOLDER. Sam H. Libby, Lynn, Mass.

500,192. ELECTRIC LIGHTING DEVICE. William H. Clewley, Providence, R. I.

500,199. PUSH-BUTTON. James S. George, Jr., Philadelphia, Pa.

500,200. PUSH-BUTTON CUT-OUT. James S. George, Jr., Philadelphia, Pa.

500,201. CUT-OUT FOR ELECTRIC LIGHTING DEVICE. James S. George, Jr., Philadelphia, Pa.

500,226. TELEGRAPHY. Charles Curtiss, New York, N. Y.

500,229. ELECTRIC CUT-OUT. Ernst Egger, New York, N. Y.

500,256. SYSTEM FOR SUPPLYING ELECTRICITY TO RAILWAYS. Michael H. Smith, Halifax, England.

500,264. GALVANOMETER. Adrian H. Hoyt, Manchester, N. H.

500,272. ELECTRIC HEATER. Charles E. Roehl, Chicago, Ill., Sydney Z. Mitchell, Portland, Ore., and Earl P. Wetmore, Helena, Mont.

500,274. REGULATING SWITCH FOR ELECTRIC ELEVATORS. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y.

500,276. ELECTRIC LOCOMOTIVE. Frank M. Stevens, White River Junction, Vt.

500,279. FILAMENT FOR INCANDESCENT ELECTRIC LAMPS. John Criggal, Newark, N. J.

500,284. GALVANIC BATTERY. Mortimer M. Hayden, New York, N. Y.

500,285. POLICE SIGNALING APPARATUS. William H. Kirnan, Bayonne, N. J.

500,288. ELECTRICAL HEATER. James F. McElroy, Albany, N. Y.

500,301. ELECTRIC GENERATOR AND MOTOR. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass.

500,306. CONDUIT RAILWAY TROLLEY. Ernest P. Warner, Chicago, Ill.

500,341. ELECTRIC ARC LAMP. Wilhelm Mathiesen, Leipsic, Germany.

500,357. ELECTRIC LIGHTER. Bernhard Tropp, New York, N. Y.

500,400. DYNAMO-ELECTRIC MACHINE OR MOTOR. Philip Lange, Pittsburg, Pa.

500,403. DYNAMO-ELECTRIC MACHINE. Frederick H. Loveridge, Chicago, Ill.

500,404. ELECTRIC INDICATOR. William B. Luce, Brookline, Mass.

500,421. HANGING DEVICE FOR ELECTRIC ARC LAMPS. Charles A. Pfluger, Chicago, Ill.

500,422. ELECTRIC ARC LAMP. Charles A. Pfluger, Chicago, Ill.

500,454. LIGHTNING-ARRESTER. William Wurdack, St. Louis, Mo.

500,455. AUTOMATIC SHORT-CIRCUIT FOR CONSTANT-CURRENT MACHINES. Alexander Wurts, Pittsburg, Pa.

500,456. AUTOMATIC CIRCUIT-BREAKER. Alexander Wurts, Pittsburg, Pa.

500,481. MAGNETIC TELEPHONE. Charles S. Forbes, London, England.

500,488. INSULATING DEVICE FOR PREVENTING ELECTRIC CURRENTS IN PIPES. Simeon D. Gratian, St. Louis, Mo.

500,506. INCLOSED CONDUCTOR FOR ELECTRIC RAILWAYS. John A. McGregor, Chicago, Ill.

500,520. ELECTRIC HEATER. Earl P. Wetmore, Helena, Mont.